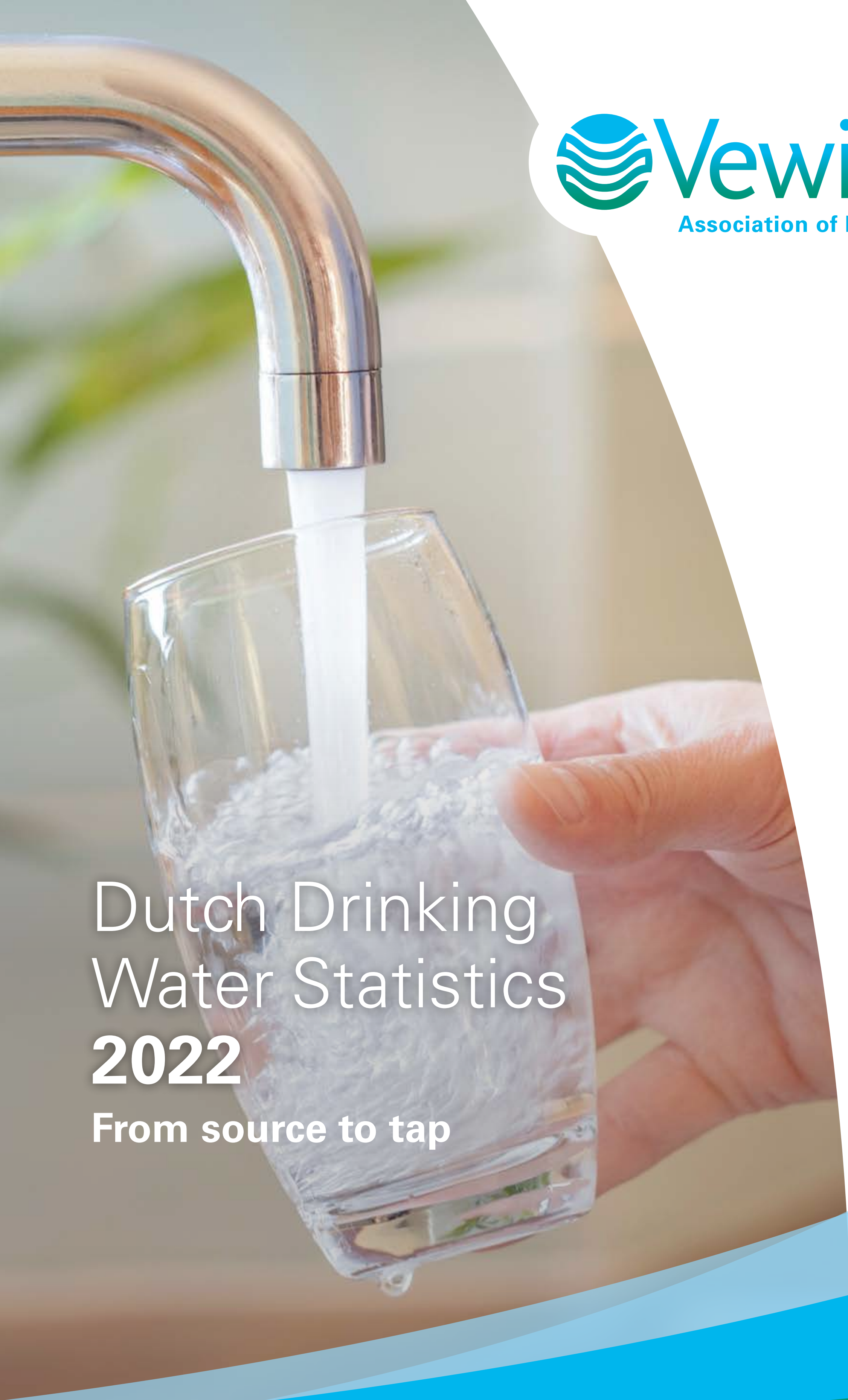
Vewin
Association of Dutch water companies



Dutch Drinking Water Statistics **2022**

From source to tap

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Preface

This is the 'Dutch Drinking Water Statistics 2022' report, a report in the 'Dutch Drinking Water Statistics' series.

Through 'Dutch Drinking Water Statistics 2022', Vewin aims to provide an up-to-date and extensive statistical overview of the Dutch drinking water sector. This way, Vewin wants to contribute to a transparent provision of information about the drinking water sector. The statistics serve to underpin policy and to provide information, for example to ministries, the media, the European Union, businesses and consumers.

'Dutch Drinking Water Statistics 2022' fits into the series of previously published editions of Dutch Drinking Water Statistics for 2008, 2012 and 2017. In addition to data on the drinking water sector (chapters 1, 3 and 4), 'Dutch Drinking Water Statistics 2022' also contains statistical information about the availability and quality of drinking water sources (chapter 2) and about the soil, nature and subsoil (chapter 6). A statistical description of the water chain is included as well (chapter 5). Finally, the Dutch drinking water sector is placed in an international perspective (chapter 7).

The drinking water companies have been participating in the drinking water benchmark since 1997, which makes the performance of the water companies transparent in the fields of water quality, service provision, the environment and finance & efficiency. The data in chapters 1, 3 and 4 is largely derived from the drinking water benchmark database. All other data is mainly derived from third-party publications.

A word of thanks is due to all organisations that contributed to the production of this report by making data available.

Special thanks is extended to the following organisations:
- AquaMinerals
- Statistics Netherlands
- Deltares
- Eurostat
- IWA
- KNMI
- KWR Water Research Institute
- RIVM
- RIWA
- Royal HaskoningDHV
- RIONED Foundation
- Association of Regional Water Authorities

Hans de Groene
Director of Vewin
The Hague, February 2022

'Dutch Drinking Water Statistics 2022' can be downloaded as an interactive PDF at **www.vewin.nl**.

1 Drinking water sector

This chapter provides an introduction to the drinking water sector. The development over time is shown for a number of sector characteristics (§ 1.1), with the most characteristic characteristics for the year 2020 specified per company. Next, the typology (§ 1.2) and the legal form (§ 1.3) of the drinking water companies are discussed. § 1.4 shows the development of the number of companies since the formation of the sector. The introduction concludes with the development of the number of employees working in the sector (§ 1.5).

1.1 General characteristics

Table 1.1 shows the development of the sector over time and Tables 1.2 and 1.3 show the main characteristics for the year 2020 per drinking water company. Figure 1.1 shows the distribution area of each company. The municipalities that are supplied with drinking water in each distribution area are listed in Appendix 1.

Table 1.1 Sector overview

	2000	2010	2015	2018	2019	2020
Number of drinking water companies	24	10	10	10	10	10
Number of employees (FTE) [1]	6,803	5,228	4,945	4,930	4,996	5,097
Number of connections (x 1,000) [2]	7,042	7,701	7,964	8,200	8,318	8,429
Drinking water supply network (x 1,000 km)	108	118	119	120	120	120
Drinking water production (million m³)	1,183	1,136	1,136	1,199	1,187	1,225
Sales (million m³)	1,127	1,090	1,081	1,140	1,128	1,159
Turnover (million €) [3]	1,418	1,442	1,356	1,344	1,338	1,396
Investments (million €)	419	458	468	534	597	643
Drinking water taxes (million €) [4]	343	403	414	449	495	516

1) Number of employees on own payroll, calculated as people working full time.

2) Number of administrative connections (service addresses) by December 31.

3) Comprises refunds for the variable rate, standing charges and/or charges for available capacity. Excluding tap water tax and VAT.

4) Groundwater tax, provincial groundwater levies, distribution and concession reimbursements, tap water tax and VAT.

Table 1.2 Indicators per supply area 2020 [1]

	Inhabitants	Surface	Employees [2]	Network
	x 1,000	*km²*	*FTE*	*km*
Brabant Water	2,563	5,016	669	18,313
Dunea	1,342	606	482	4,954
Evides Waterbedrijf	2,056	3,500	569	12,465
Oasen	790	1,115	249	4,230
PWN	1,749	2,465	550	10,137
Vitens	5,807	15,147	1,282	48,427
Waternet	1,058	350	495[3]	2,782
Waterbedrijf Groningen	600	2,403	218	5,261
WMD Drinkwater	438	2,468	186	4,869
WML	1,116	2,209	395	8,807
The Netherlands	17,519	35,279	5,097	120,244

1) By December 31, 2020.

2) Full-time equivalents own payroll.

3) FTEs working for water supply only.

Table 1.3 Drinking water per supply area 2020

	Connections [1]	Production	Sales [2]	Turnover [2]
	x 1,000	*million m³*	*million m³*	*million €*
Brabant Water	1,246	200	187	171
Dunea	644	82	77	131
Evides Waterbedrijf	1,104	174	158	213
Oasen	362	44	49	73
PWN	824	96	109	178
Vitens	2,668	382	363	357
Waternet	528	93	69	96
Waterbedrijf Groningen	294	46	46	48
WMD Drinkwater	206	36	30	33
WML	554	72	72	96
The Netherlands	8,429	1,225	1,159	1,396

1) Number of administrative connections by December 31, 2020.

2) Of drinking water supplied in own supply area.

Figure 1.1 Distribution areas

1.2 Typology

All ten drinking water companies produce and distribute drinking water. In addition to the ten drinking water companies, Watertransportmaatschappij Rijn-Kennemerland (WRK) and Waterwinningsbedrijf Brabantse Biesbosch (WBB) are active in the drinking water sector. WRK and WBB do not distribute drinking water, but supply partially treated water to the drinking water companies and to industry. Waternet and PWN are responsible for the operational management of WRK, while Evides is responsible for the operational management of WBB.

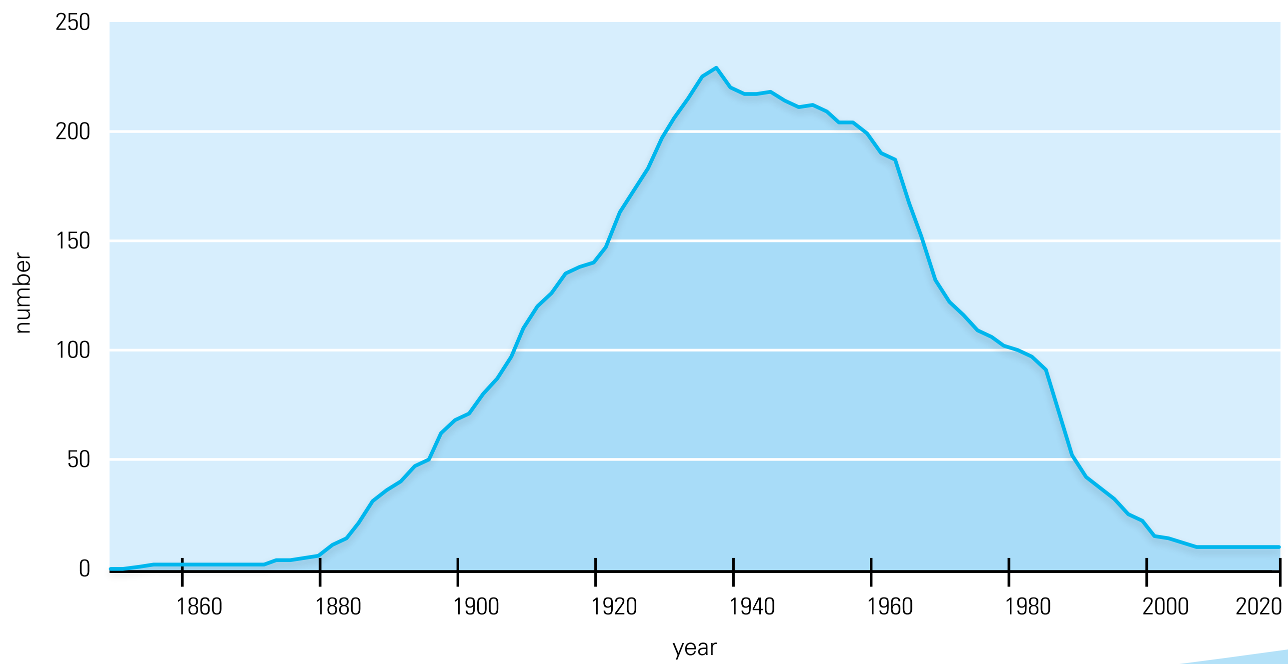
In addition to drinking water production and distribution, Waternet is also involved in the processing of wastewater and the management of groundwater and surface water. Various drinking water companies have subsidiaries or sister companies that are active in the industrial water supply, such as Evides Industriewater. Evides Industriewater also focuses on wastewater treatment.

1.3 Legal form

Nine out of ten drinking water companies are public limited companies, with municipalities and provinces as shareholders. One of these public limited companies, N.V. Waterbedrijf Drenthe, carries out its statutory drinking water tasks as a private limited company established especially for this purpose: WMD Drinkwater B.V.

The tenth drinking water company, Waternet, is not a public limited company, but a foundation. Stichting Waternet was established by the Municipality of Amsterdam and the Amstel Gooi en Vecht Water Authority. In addition to the supply of drinking water, this foundation is responsible for the municipal sewage system and the operational activities of the water authority.

Figure 1.2 Development of the number of drinking water companies



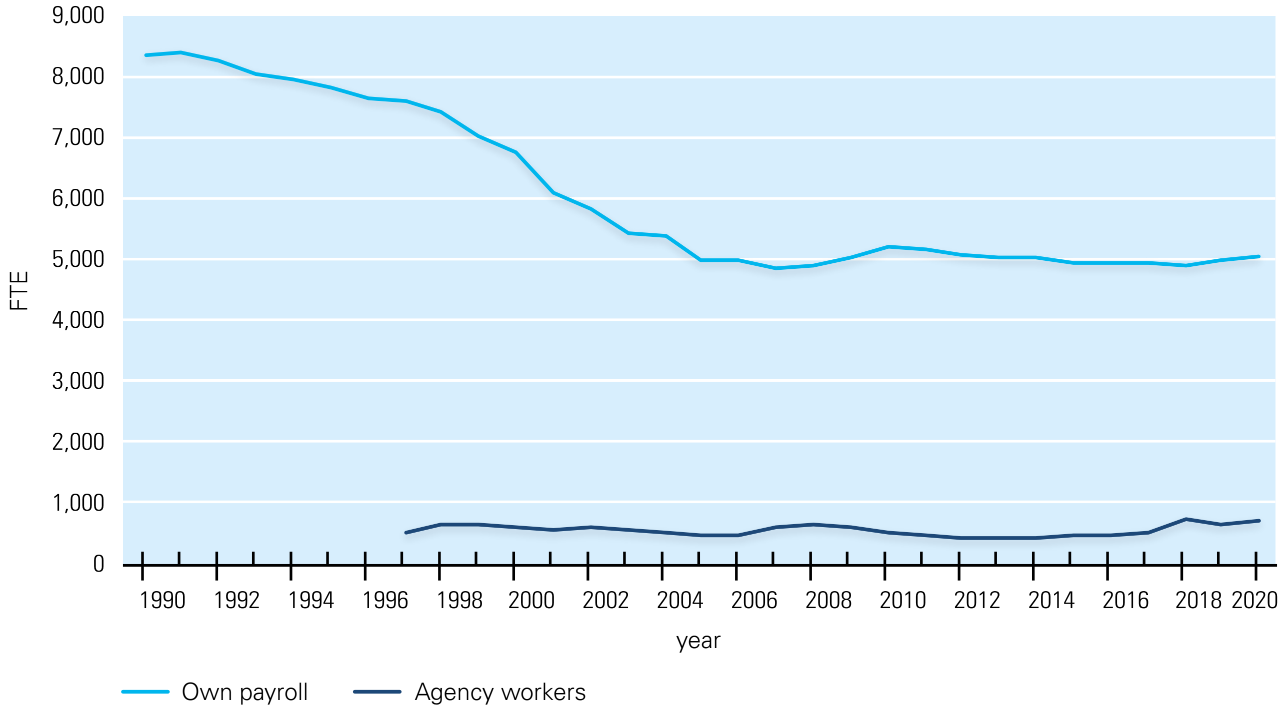
1.4 Development of the number of companies

The first water companies were formed in the middle of the 19th century, starting with the Amsterdam water company. Gradually, more and more water companies arose and the whole of the Netherlands was connected to the water supply network. Later on, mergers reduced the number of companies. The development of the number of drinking water companies is shown in Figure 1.2. At present, ten drinking water companies provide the whole of the Netherlands with drinking water.

1.5 Personnel

Figure 1.3 shows the development of the workforce in the sector. Between 1990 and 2005, the number of FTEs on the payroll of drinking water companies fell by more than 40%. Afterwards, the number of FTEs long continued to fluctuate around 5000, but this has increased slightly since 2019. In 2020, the number of FTEs is 5097, plus an additional 717 FTEs in the form of agency workers to complement the workforce.

Figure 1.3 Workforce development



2 Availability and quality of sources

Water companies are bound by the environment in which they operate. Which drinking water sources are available (§ 2.1)? And what is the quality of those sources (§ 2.2)? This chapter contains statistical data on these aspects and considers the effects of climate change on those aspects.

2.1 Availability of sources

2.1.1 Freshwater supply

Figure 2.1 shows the national freshwater balance for the year 2018. Table 2.1 also shows the average for the years 1981-2010. The long-term average of the precipitation surplus amounts to approximately 10 billion m³ per year and amounted to approximately 8 billion m³ in 2018. The precipitation surplus is precipitation minus evapotranspiration. Evapotranspiration is the combination of direct evaporation and evaporation from plant leaves (transpiration). The rivers supply an average of approximately 82 billion m³ annually.

In 2018, this was approximately 71 billion m³. Added together, the precipitation surplus and the river supply form an available amount of freshwater of an average of 92 billion m³ per year, of which 91 billion m³ is discharged back to the sea via the rivers (Eurostat, 2021). In 2018, freshwater availability was approximately 79 billion m³ and approximately 74 billion m³ was discharged. The total freshwater groundwater resources in the Netherlands is estimated at 1,100 billion m³ (TNO, 2008).

Table 2.1 National freshwater balance 2018 versus long term (billion m³)

	2018	Long-term annual average [1]
A. Precipitation	25.2	31.6
B. Evapotranspiration	16.9	21.3
C. Precipitation surplus (=A-B)	8.3	10.3
D. External supply (total)	71.2	81.5
Rivers	70.7	
Groundwater	0.5	
E. Renewable freshwater resources (=C+D)	79.5	91.8
F. Outflow	73.9	90.9

1) Period 1981-2010.

(Eurostat, 2021)

Figure 2.1 National Freshwater Balance 2018 (billion m³)

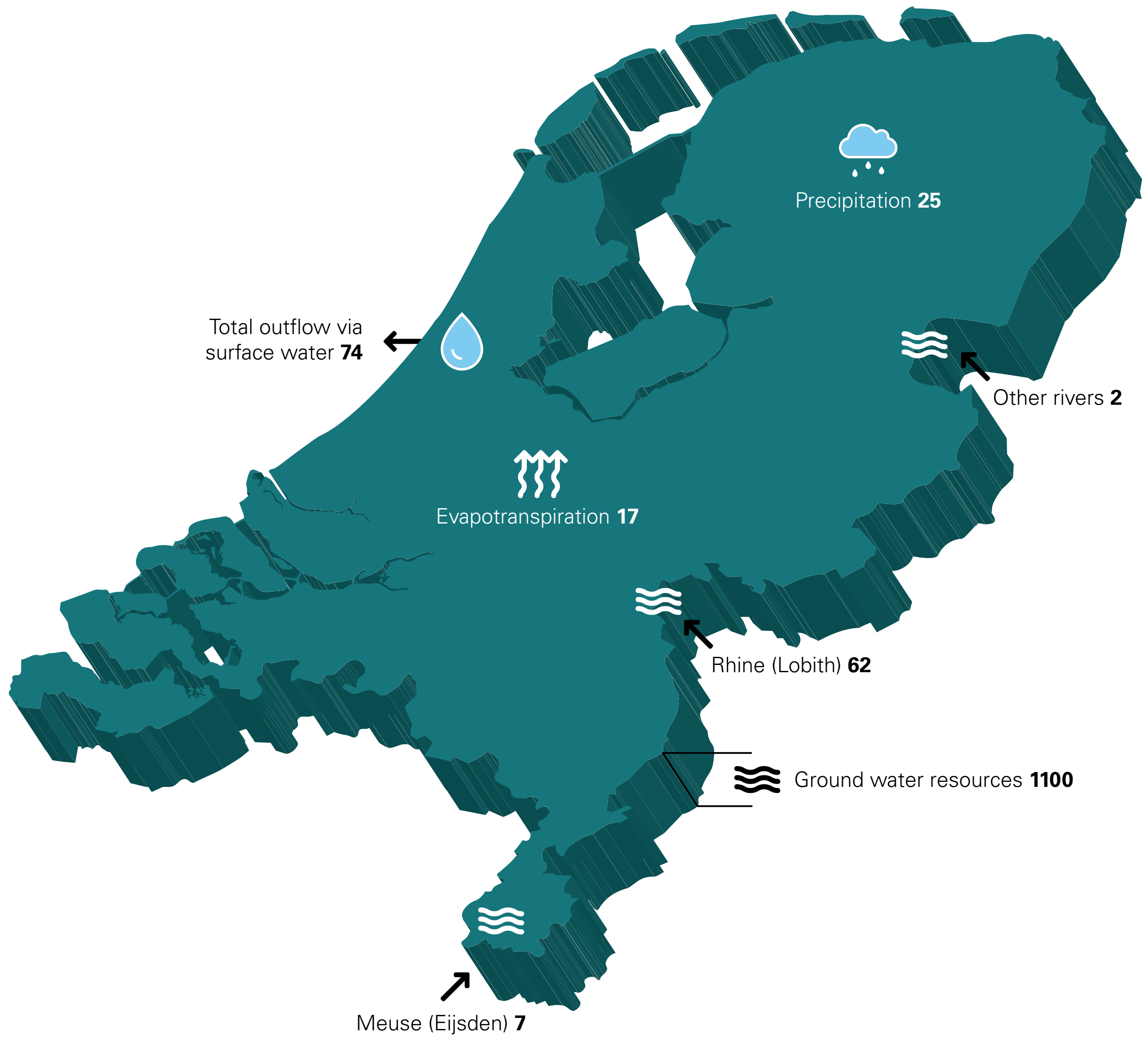


Table 2.2 shows the abstractions from the water system in 2019, broken down by type of users (Statistics Netherlands, 2021). A total of 14.7 billion m³ of water was extracted, of which 1.1 billion m³ groundwater and 13.5 billion m³ surface water. Of the total surface water abstraction in 2019, 7.3 billion m³ was freshwater and 6.2 billion m³ saltwater.

According to figures of Statistics Netherlands, total water extraction by agriculture, forestry and fishing amounted to 253 million m³ in 2019, three times as much as in 2014 (83 million m³); Between 2014 and 2019, surface water extraction in this sector increased from 22 to 55 million m³ and groundwater extraction from 61 to 199 million m³. However, many small groundwater abstractions are not subject to a permit or notification requirement, and not all water authorities impose an obligation to state the abstracted quantities for irrigation purposes (IenW, 2021 and IPO & UvW, 2021). Therefore, the actual quantities of water abstracted by agriculture are probably considerably higher than suggested by the figures of Statistics Netherlands.

Compared to 2014, water extraction in the industrial sector fell by 3% and extraction in the energy supply sector fell by 5%.

In 2019, the drinking water sector abstracted 1.3 billion m³ of water: approximately 810 million m³ of groundwater and 492 million m³ of surface water. In 2014 this was 1.2 billion m³: 758 million m³ of groundwater and 466 million m³ of surface water. In 2019, abstractions for drinking water preparation amounted to 8.9% of total abstractions by the various sectors. Compared to the amount of water that was discharged from the Netherlands in 2018 (see Table 2.1), this is 1.8%.

§3.2 discusses the water extraction by the drinking water sector in more detail. The water extracted by the drinking water companies is used to prepare drinking water and other types of water (§3.3). The drinking water preparation is made up of 59% of groundwater, 34% surface water, 6% riverbank filtration water and 1% of natural dune water.

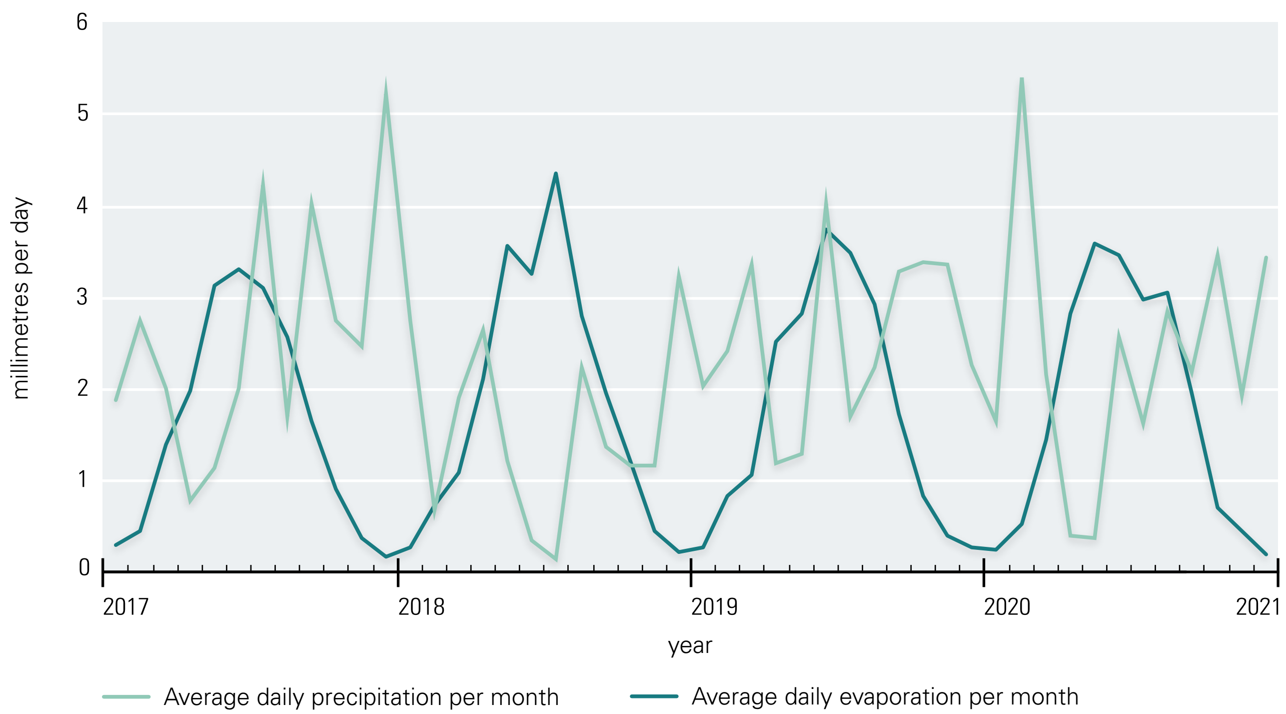
Table 2.2 Water extraction in the Netherlands in 2019 (million m³)

	Total	Groundwater [1]	Surface water		
			Total	*Freshwater*	*Saltwater*
Drinking water companies	1,302	810	492	492	-
Agriculture, forestry and fishing	253	199	55	55	-
Industry	3,034	128	2,906	2,285	621
Energy supply	9,369	4	9,365	3,767	5,599
Other	694	3	691	663	28
Total	14,653	1,144	13,509	7,260	6,249

1) Use of water that is pumped up from the subsoil or that otherwise surfaces. This can be freshwater, but also brackish or saltwater.

(Statistics Netherlands, 2021)

Figure 2.2 Pattern of precipitation and evaporation throughout the year (De Bilt)



(KNMI, 2021)

2.1.2 Development of precipitation surplus throughout the year and climate change

The national freshwater balance set out in the previous section shows that the Netherlands has an annual precipitation surplus. Over the entire year of 2018, for example, the precipitation surplus was 8.3 billion m³. However, this precipitation surplus is not evenly distributed over the year. The autumn and winter are characterised by a surplus, but in the spring and summer there is a shortage.

Figure 2.2 shows how the ratio between precipitation and evaporation differs in the Netherlands throughout the year. The graph is based on data from the Royal Netherlands Meteorological Institute (KNMI) of the De Bilt monitoring station and may differ regionally. On average, the Netherlands has a precipitation deficit (precipitation < evaporation) in the months of April to September and a precipitation surplus (precipitation > evaporation) during the rest of the year.

Approximately once every 7 years, the KNMI prepares new climate scenarios for the Netherlands, partly on the basis of reports from the Intergovernmental Panel on Climate Change (IPCC). The most recent climate scenarios for the Netherlands date from 2014. New scenarios will be published in 2023 based on the 2021 IPCC report and KNMI's own research. The KNMI has published an interim state of affairs in its Climate Signal '21 report (KNMI, 2021). Climate change means that the average climate changes, while the risk of extreme weather events increases as well. Average temperatures will rise and precipitation patterns will change. Mild winters and hot summers will become more frequent. Since the air in a warmer climate can contain more moisture, showers will be more extreme. Precipitation and extreme precipitation will increase in the winter and the intensity of rain, hail and thunderstorms will increase in the summer as well. Due to the higher temperatures and more solar radiation, evaporation increases. This increases the risk of drought in the spring and summer. The risk of low water levels in the rivers also increases in the summer and the risk of high water increases in the winter (KNMI, 2021).

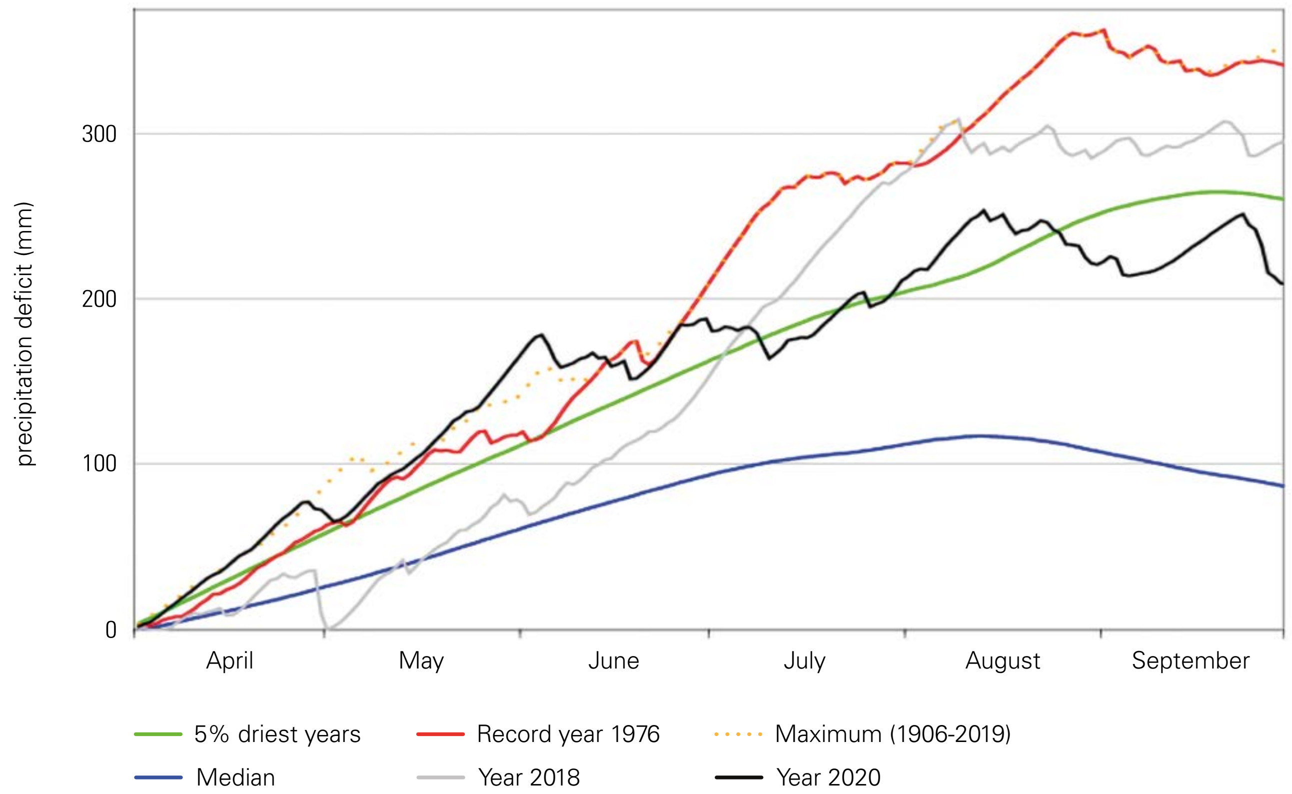
In the past years, the Netherlands already experienced weather extremes in practice. Table 2.3 shows a number of weather statistics from 2018 to 2020, compared to the long-term average from 1991 to 2020. It is striking that there were significantly fewer ice and frost days and more hot, summery and tropical days. The average temperature and the number of hours of sunshine between 2018 and 2020 were higher compared to the long-term average and the amount of precipitation lower.

Table 2.3 Weather statistics 2018 – 2020 compared to long-term averages

	Long-term average 1991 - 2020	2018	2019	2020
Description by KNMI		Extremely hot, extremely sunny and very dry	Very hot, very sunny and a national average that is quite dry	Extremely hot, very sunny and on the dry side
Ice days *(a maximum temperature below 0.0 °C)*	8	3	2	0
Frost days *(a minimum temperature below 0.0 °C)*	59	50	40	31
Hot days *(a maximum temperature of 20.0 °C or higher)*	85	132	99	110
Summery days *(a maximum temperature of 25.0 °C or higher)*	26	55	26	32
Tropical days *(a maximum temperature of 30.0 °C or higher)*	4	9	11	12
National average temperature	10.5 °C	11.3 °C	11.2 °C	11.7 °C
National average number of hours of sunshine	1,639	2,090	1,964	2,026
National average precipitation *(mm)*	847	607	783	785

(KNMI, 2021)

Figure 2.3 National average precipitation deficit in the Netherlands in perspective [1)]



1) National average of 13 stations.

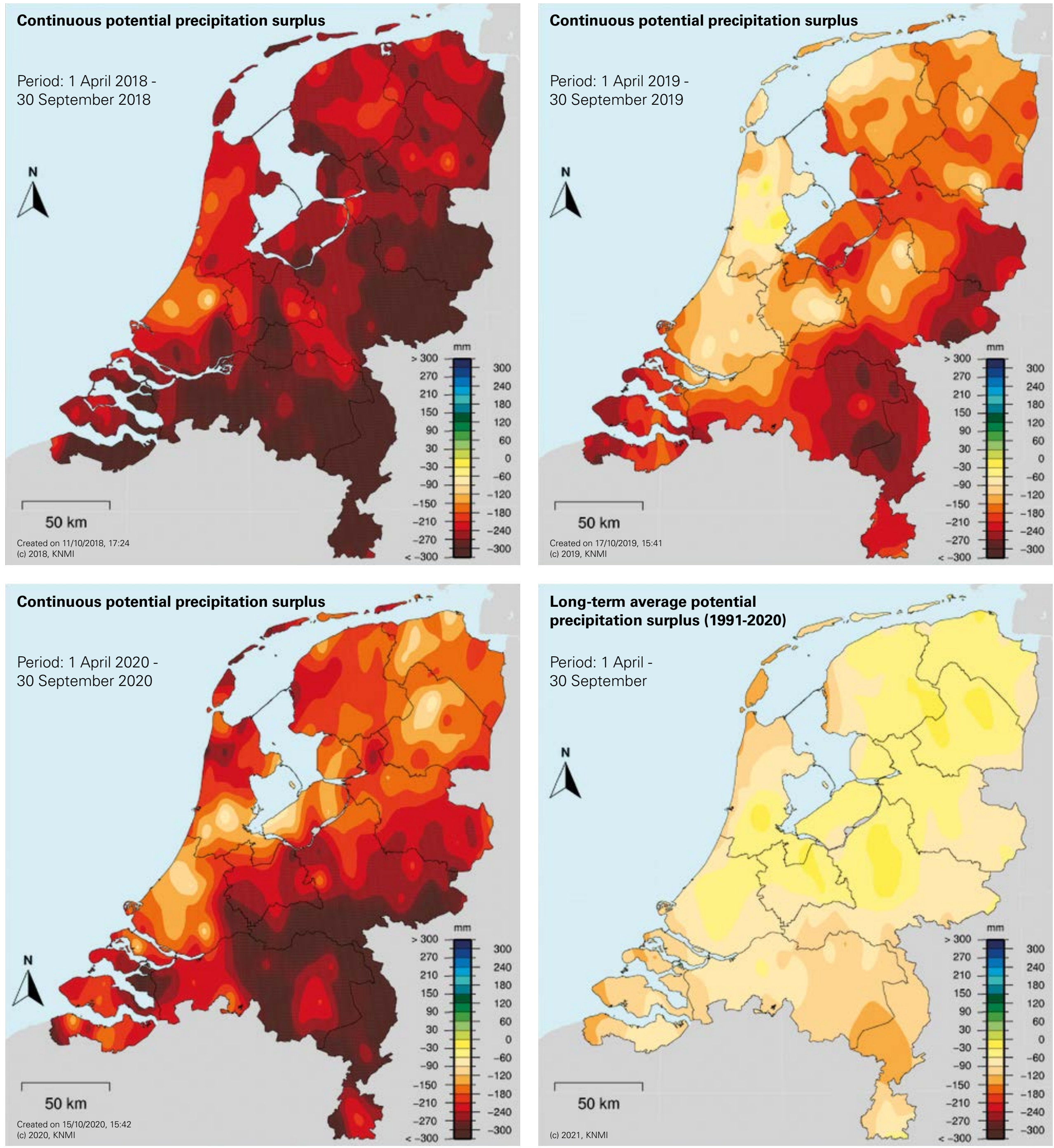
(KNMI, 2021)

Each year, the KNMI monitors the increasing precipitation deficit between 1 April and 30 September. Figure 2.3 puts the precipitation deficit of 2018 and 2020 in perspective with the driest year ever measured in the Netherlands (1976), the median of the precipitation deficit and the average of the 5% driest years between 1906 and 2019.

Figure 2.4 geographically shows the total precipitation surplus[1] for the April-September period in the years 2018-2020 compared to the long-term average (1991-2020). Both figures show that recent years have been very dry. The long-term average precipitation surplus varies regionally between 0 and -150 mm, whereas in the past 3 years, in large parts of the Netherlands, it was between -150 and -300 mm. Consequently, the availability of water for the drinking water supply came under pressure (see § 2.1.4).

1 *This concerns the continuous 'potential precipitation surplus' (in millimetres) that is obtained by calculating the difference between the amount of precipitation and the calculated reference crop evaporation. The maps in Figure 2.4 show a negative precipitation surplus, which equates to a precipitation deficit.*

Figure 2.4 Precipitation surplus in 2018, 2019 and 2020 compared to the long-term average



(KNMI, 2021)

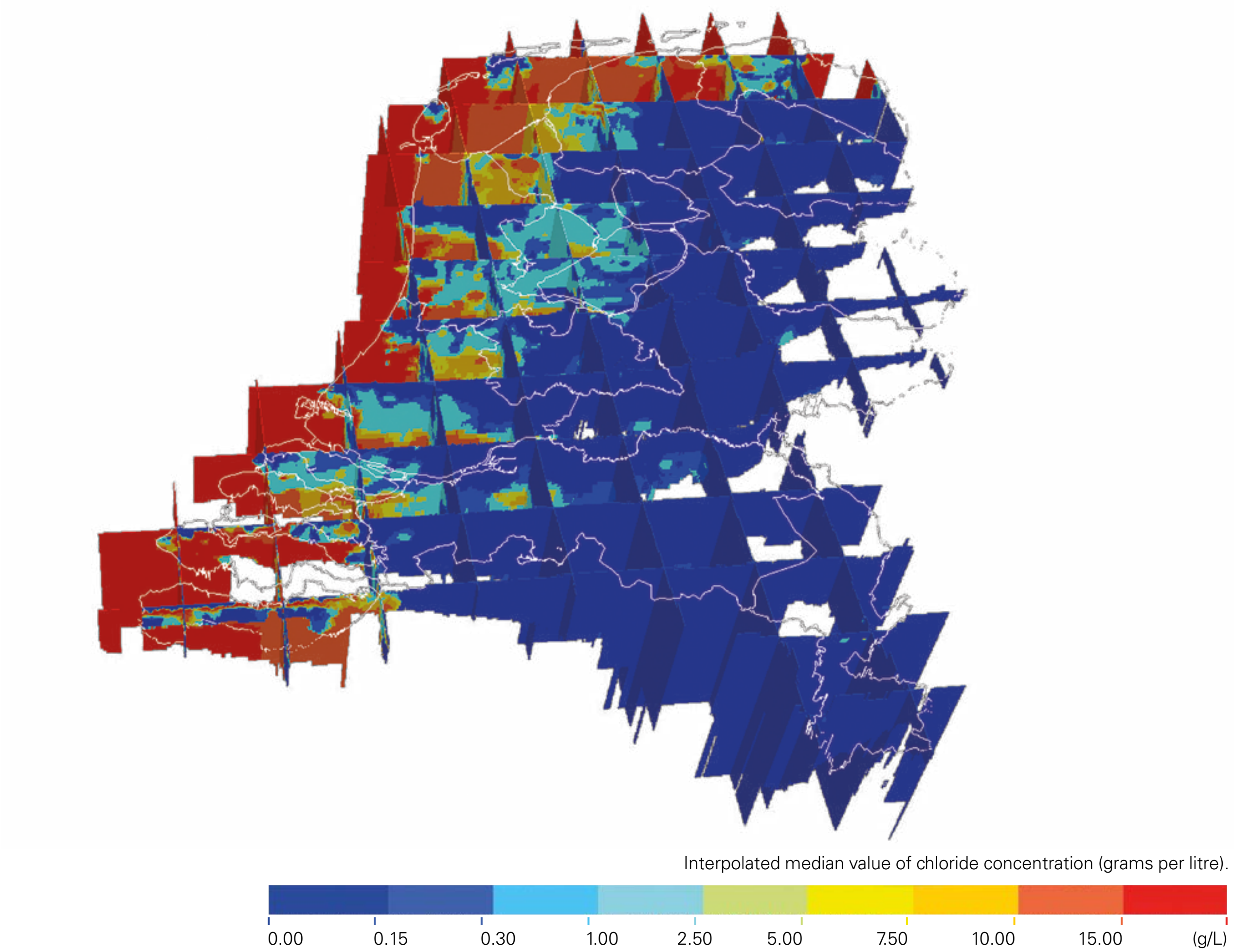
2.1.3 Reduced availability due to salinization

Freshwater availability for the drinking water supply is further pressurised due to salinization. Various groundwater extraction sites already suffer from excessively salty groundwater and the water in Lake IJssel near Andijk too has been too salty several times in recent years to take in for drinking water preparation (Table 2.4, Figure 2.14).

The groundwater and surface water in the Dutch coastal area becomes saline due to the intrusion of seawater (external salinization) and also due to the upward flow of saline groundwater to the surface: saline seepage (internal salinization). Climate change means that sea levels are rising, making both forms of salinization more common. Besides, saline seepage is increasing as a result of soil subsidence and also because rivers become saltier during periods of extreme drought as a result of reduced water discharge.

The boundary between fresh and brackish water is at 150 mg chloride per litre and that between brackish and salt water at 1000 mg per litre. The availability of freshwater, necessary for the (basic) production of drinking water, is decreasing due to salinization. Figure 2.5 provides a three-dimensional picture of chloride concentrations in the Netherlands at different depths. In the coastal areas, the salt water is just below the surface, with a freshwater bubble under the dunes. Inland, the groundwater is predominantly fresh (Deltares, 2020).

Figure 2.5 3-D image of saline groundwater depth



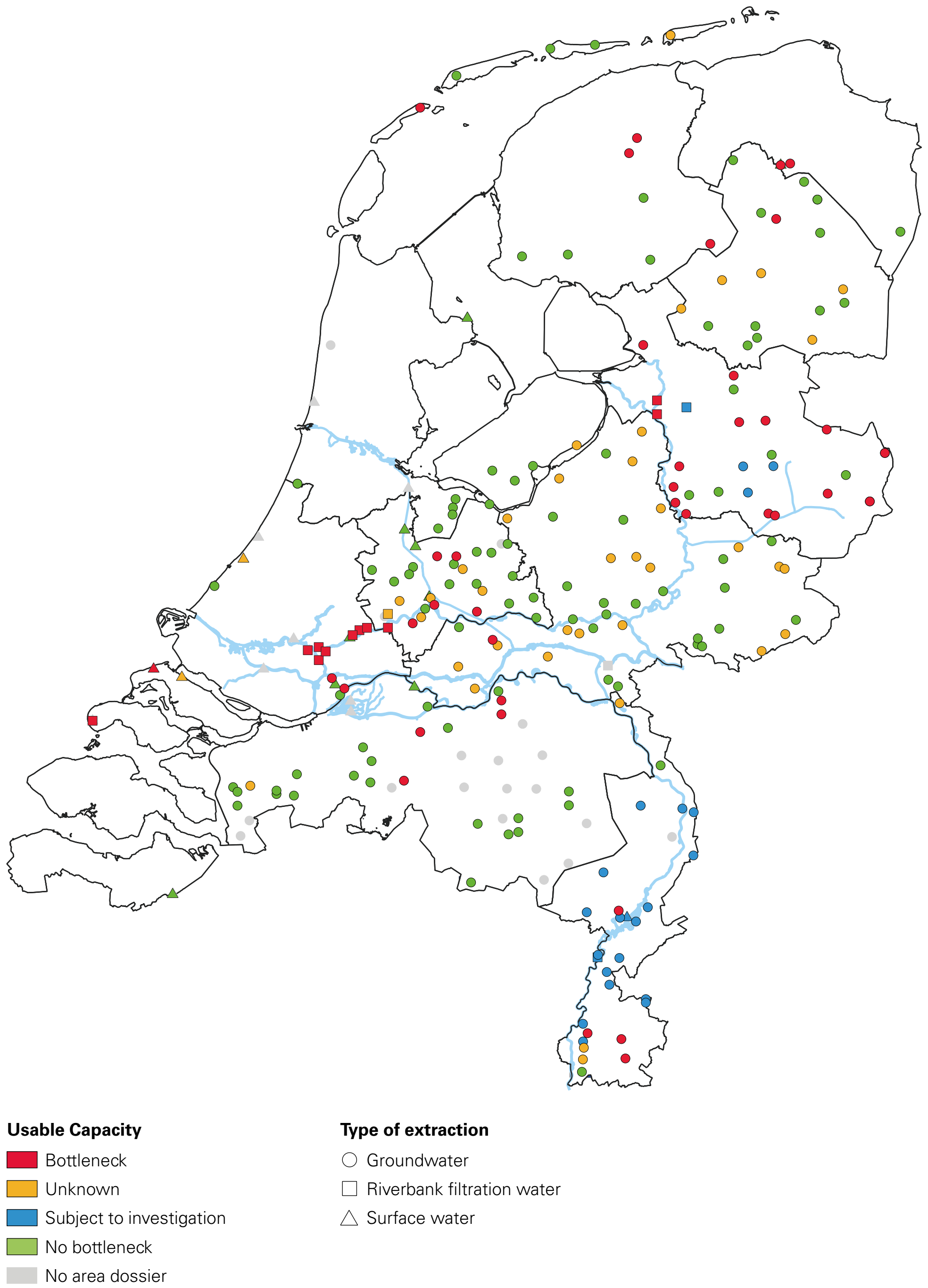
(Deltares, 2020)

2.1.4 Issues in usable capacity

Within the framework of the Water Framework Directive, periodic area dossiers are drawn up for all drinking water extraction sites under the direction of the provinces (in collaboration with drinking water companies, municipalities and water authorities). As regards surface water extraction sites, this is organised under the direction of the Directorate-General of Public Works and Water Management or a water authority. The area dossiers provide insight and information about the state of drinking water extraction sites in terms of water availability and water quality (§ 2.2) and about the causes of contaminants that pose a risk to those sites. The province needs this information to protect the drinking water extraction areas.

An analysis by the RIVM of the 2018 area dossiers shows that 23% of extraction sites are dealing with issues with regard to usable extraction capacity (Van Driezum et al., 2020). The extraction sites concerned

Figure 2.6 Issues in usable capacity at drinking water extraction sites



(Van Driezum et al., 2020)

are shown in Figure 2.6. The causes mentioned are restrictions with a view to nature, (imminent) desiccation, rising salinized groundwater and (for surface water extraction) extreme fluctuations in the supply. In addition, the rise in soil contamination is mentioned.

2.1.5 Additional Strategic Resources and National Groundwater Reserves

As regards the drinking water supply, it is important to not only look at the current availability of sources for the production of drinking water, but to also anticipate future availability.

In 2018, the Ministries of Infrastructure and Water Management (IenW) and Economic Affairs and Climate (EZK) drew up a joint vision for the subsoil, the so-called Subsoil Structural Vision (STRONG). This focuses on sustainable, safe and efficient use of soil and subsoil, in which utilisation and protection are in balance (IenW & EZK, 2018). An important theme in this regard is the future availability of sources for the drinking water supply.

Figure 2.7 provides an overview of the National Groundwater Reserves (NGR) designated in STRONG in 2018 and of the additional strategic groundwater resources (ASV) already designated by the provinces for the drinking water supply. NGRs are deep, very old and clean groundwater supplies, which are valuable as natural capital and that can be used for drinking water supply in the event of a large-scale crisis. In STRONG, provinces/drinking water companies were asked to explore where additional ASVs for the drinking water supply would be desirable to meet the long-term demand for drinking water. The figure also shows these potential ASVs, which were named in the final report 'Exploring the robust drinking water supply 2040' (Royal HaskoningDHV, 2021). These (potential) ASVs still have to be determined administratively by the provincial authorities.

2.2 Quality of sources

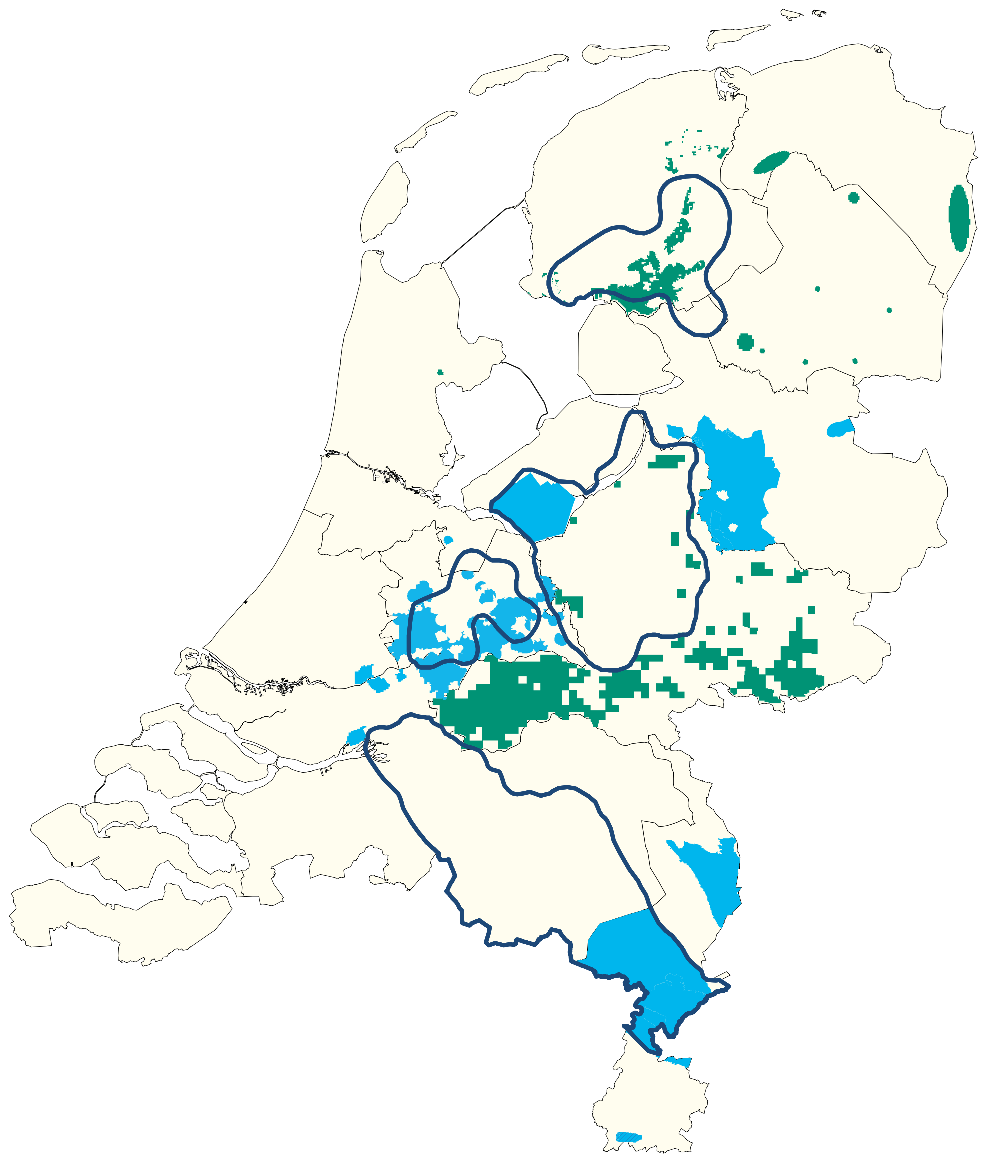
In the previous section, the focus was on the increasingly limited availability of freshwater for drinking water. The availability of sources for drinking water preparation is also under increasing pressure, as a result of insufficient quality, due to the increasing presence of problematic substances. This section discusses this in more detail. § 2.2.1 starts with an overall picture of the presence of problematic substances in drinking water sources. Subsequently, § 2.2.2 zooms in on the quality of the surface water and § 2.2.3 on the quality of the groundwater.

2.2.1 Status of drinking water sources

The European Water Framework Directive is an important legal framework to protect groundwater and surface water systems. Article 7.3 of this Directive states that Member States must protect the water bodies intended for drinking water production with the aim of preventing deterioration of the water quality, so that in the long term, the treatment effort for drinking water production can be reduced.

In 2020, RIVM published the report 'Status of drinking water sources', about the quality of groundwater and surface water that is used for drinking water production (Van Driezum et al., 2020). The conclusion of the report is that securing the condition of drinking water sources for the future will be a major task. In addition to problems with the available quantity of water (§ 2.1), more than half of the extraction sites are having quality issues (Figure 2.8). In 135 of the 216 extraction sites (potentially) problematic substances are present and due to the drought of recent years, concentrations of contaminants are rising.

Figure 2.7 National Groundwater Reserves and Additional Strategic Resources



National groundwater reserves
Additional strategic groundwater resources
Potential additional strategic groundwater resources

(Royal HaskoningDHV, 2021)

Figure 2.8 Overview of extraction sites with one or more (potentially) problematic substances

Problematic substance categories

- Current problematic substance found in extraction site
- Potential problematic substance found in extraction site
- Current problematic substance found in the observation wells
- No problematic substances found
- No area dossier

Type of extraction

- Groundwater
- Riverbank filtration water
- Surface water

(Van Driezum et al., 2020)

2.2.2 Surface water

2.2.2.1 Protection of surface water intended for drinking water production

About 34% of our drinking water is prepared from surface water. Surface water for the preparation of drinking water is mainly used in the western part of the Netherlands. In addition, approximately 6% is prepared from riverbank filtration water.

Figure 2.9 shows the intake points for surface water, the intake points for riverbank filtration water, the infiltration lakes and storage reservoirs that are currently used for drinking water production. The figure further shows surface water sources (such as Lake IJssel and Drentsche Aa) from which water is abstracted for the production of drinking water.

With the exception of Drentsche Aa, surface water extraction sites do not have a protection regime as seen at groundwater extraction sites. The surface water intended for the production of drinking water must meet the quality requirements described in the Water Quality Requirements and Monitoring Decree 2009. The Directorate-General of Public Works and Water Management and the water authorities must ensure that the water meets these quality requirements.

2.2.2.2 Surface water quality

The surface water that is used as a source for the drinking water supply is under pressure due to the environmental load involving pesticides, pharmaceuticals and industrial substances. Moreover, surface water as a source of drinking water is under pressure due to climate change. At low river discharges, the influence of wastewater and industrial discharges is stronger (the discharges are less diluted), which has adverse consequences in terms of the water quality (Van Driezum et al., 2020).

Intake stops and restrictions at drinking water intake points

If the quality of the surface water taken in does not meet the requirements, drinking water companies will take measures such as mixing in groundwater or a temporary stop on the intake of surface water. In addition, together with water authorities, they trace the origin of the pollution to tackle it at the source as much as possible.

Table 2.4 shows the number of days of intake stops and restrictions at intake points for drinking water along the Rhine and Meuse for the past decade. Since the concentrations of substances increase at low river water discharges, the water quality was under extra pressure in the dry summers of 2018 – 2020. In addition, when locks were closed, more salt water entered Lake IJssel from the Wadden Sea. The intake stops for the Rhine since 2018 are almost all due to too high a chloride concentration in Lake IJssel at Andijk pumping station (RIWA-Rhine, 2021).

Table 2.4 Intake stops and restrictions at drinking water intake points (days)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Rhine	13	4	15	39	24	6	0	90	37	60
Meuse	65	114	126	209	478	308	59	46	65	174

(RIWA-Rhine, 2021 and RIWA-Meuse, 2021)

Figure 2.9 Surface water for drinking water production

(KWR, 2021)

Emerging substances

Emerging substances are substances that are not (legally) standardised, the harmfulness of which has not yet been (fully) established, but of which there is a suspicion that they can be harmful to people and the environment. In drinking water regulations, the term other anthropogenic substances is used to refer to these substances. This concerns a large group of micropollutants, including endocrine disrupting substances, microplastics, industrial products and pharmaceuticals (RIVM, 2017).

Table IIIc of the Drinking Water Decree contains signalling parameters that serve as a framework for identifying new or unknown substances and determining their risks. A substance is a problematic substance if the signalling value from the Drinking Water Decree is exceeded once or more times.

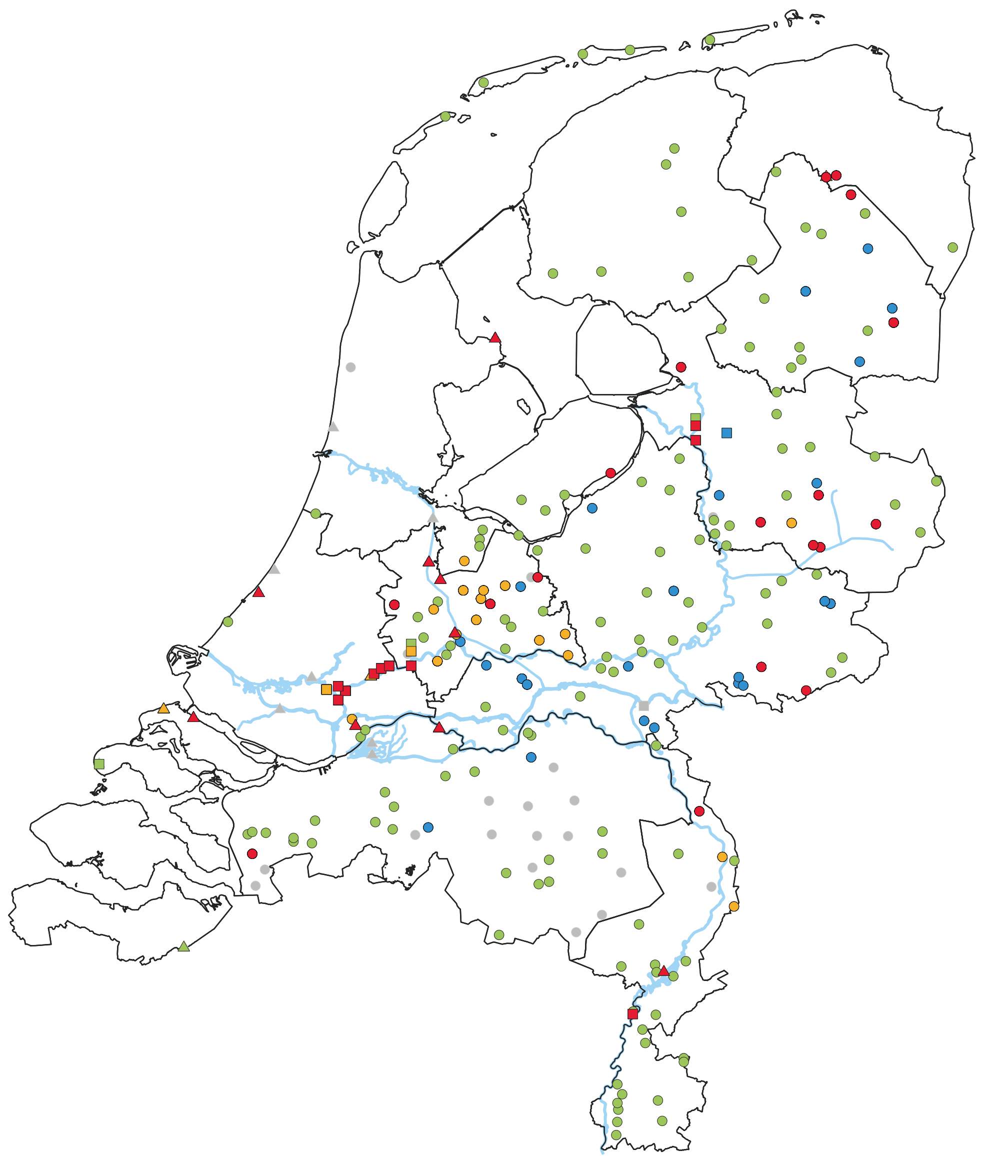
Figure 2.10 provides an overview of extraction sites for which an area dossier was drawn up in 2018 and in which one or more emerging substances have been identified as a current or potentially problematic substance or that have been found in an observation well (Van Driezum et al., 2020). Emerging substances are an issue for almost all surface water and riverbank filtration water extractions sites, especially in the Rhine delta area. Emerging substances are found in 92% of surface water extraction sites and in 93% of riverbank filtration water extraction sites. In surface water extraction sites, it mainly concerns pharmaceuticals and in riverbank filtration water extraction sites, it mainly concerns degradation products of said pharmaceuticals (industrial substances) (Van Driezum et al, 2020).
At 10 riverbank filtration water and 9 surface water extraction sites, emerging substances are classified as a current problematic substance and 2 and 3 times respectively as a potentially problematic substance.
A potentially problematic substance means that 75% of the signalling value from the Drinking Water Decree (2011) or the target value of the Danube, Meuse and Rhine Memorandum is exceeded.
(Van Driezum et al., 2020).

The RIVM estimates that in the Netherlands, at least 190 tons of pharmaceutical residues are discharged into the surface water via the sewage system, whereas in 2016, this was still estimated at 140 tons (Moermond et al., 2020; RIVM, 2016). Vewin is working with the Association of Regional Water Authorities on the Chain Approach to reduce Pharmaceutical Residues in Water. This approach focuses on the entire pharmaceutical chain, from the development of pharmaceuticals and their application to filtering from wastewater. Measures being worked on include the use of urine bags to keep X-ray contrast media out of sewage and the expansion of sewage treatment plants with additional treatments steps. The partners are also working on promoting through information that surplus medicines are returned to the pharmacy and not flushed down the sewer.

Fertilisers

Increased nutrient concentrations can occur in surface water due to, among other things, fertilisation of agricultural land, effluent from sewage treatment plants (STPs), overflow points in the sewage system and industrial discharges (Groenendijk et al., 2016; Schipper et al., 2015; Vink, 2007). In the Netherlands, it is mainly the nutrients phosphorus and nitrogen that cause environmental problems. Phosphorus in particular is a point of concern for drinking water production from surface water. A high concentration of this fertiliser can lead to problems in the infiltration dunes or impede the realisation of nature-related objectives (Van Driezum et al, 2020; Aggenbach and Annema, 2016). That is why phosphorus is removed from the surface water beforehand. Nitrate in particular poses a problem at groundwater extraction sites (see § 2.2.3.2).

Figure 2.10 Emerging substances in drinking water sources

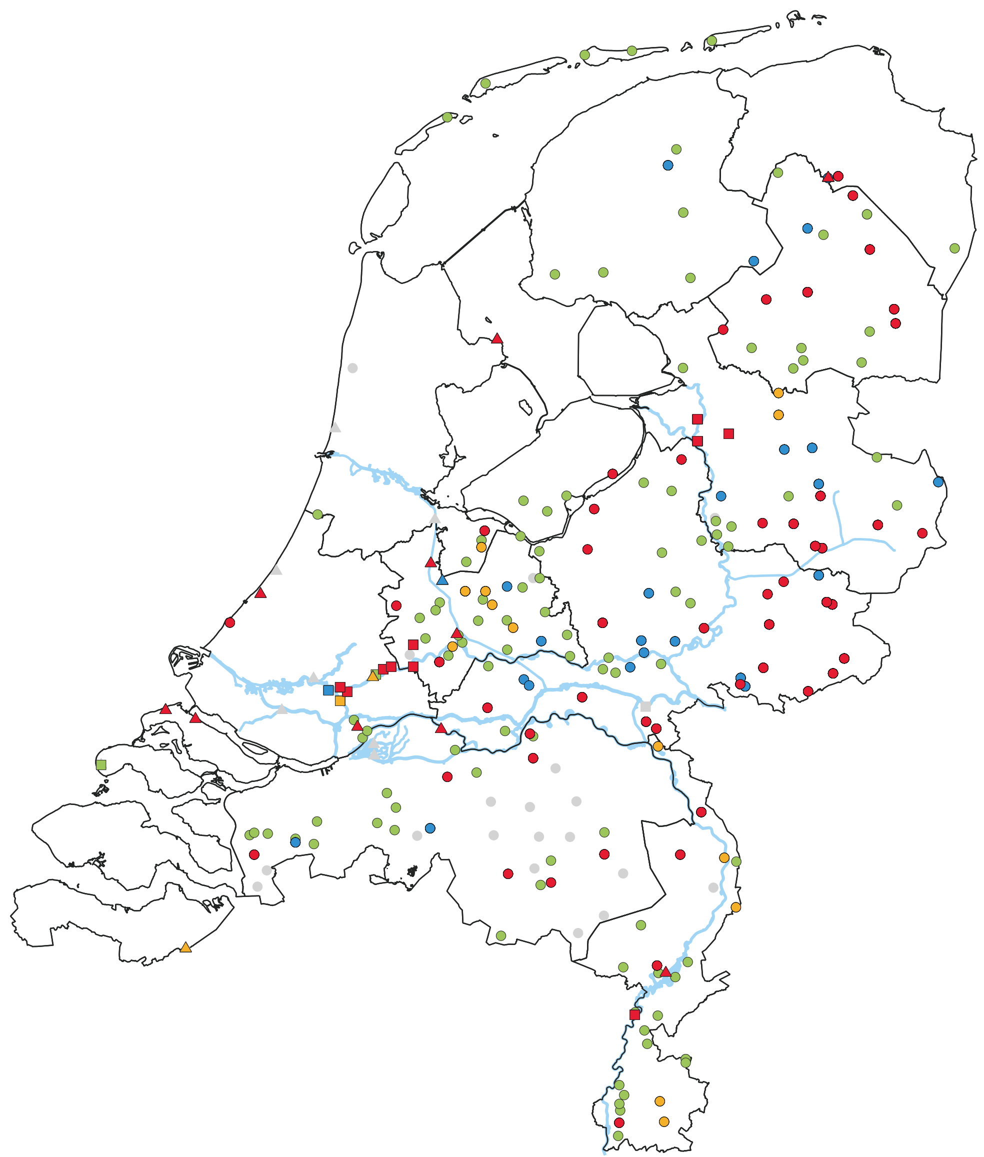


Problematic substance categories
- Current problematic substance found in extraction site
- Potential problematic substance found in extraction site
- Current problematic substance found in the observation wells
- No problematic substances found
- No area dossier

Type of extraction
- Groundwater
- Riverbank filtration water
- Surface water

(Van Driezum et al., 2020)

Figure 2.11 Pesticides in drinking water sources



Problematic substance categories
- Current problematic substance found in extraction site
- Potential problematic substance found in extraction site
- Current problematic substance found in the observation wells
- No problematic substances found
- No area dossier

Type of extraction
- Groundwater
- Riverbank filtration water
- Surface water

(Van Driezum et al., 2020)

Pesticides

'Crop protection agents' are pesticides that are used in agriculture, by site managers and citizens to protect (agricultural) crops against diseases and pests and 'biocides' are pesticides that are used for, among other things, the control of nuisance animals. In the Netherlands, many different pesticides are found in the surface water and groundwater (§ 2.2.3.2). Pesticides can end up in the surface water through wind and run-off from the soil to surrounding surface waters (Statistics Netherlands, PBL & WUR, 2016b). Biocides, used in industry and households, can end up in surface waters via the effluent of STPs (RIVM, 2010).

Drinking water companies regularly find pesticides in drinking water sources that exceed the drinking water criterion of 0.1 micrograms (0.0000001 grams) per litre. Pesticides that pose a problem for the drinking water production include glyphosate and its breakdown product (metabolite) aminomethylphosphonic acid (AMPA).

Figure 2.11 shows at which drinking water extraction sites pesticides form a (potentially) problematic substance. In 70 of the 216 extraction sites, of which 10 are surface water and 10 riverbank filtration water extraction sites, pesticides are found in concentrations that exceed the standard and that are classified as problem substances. Pesticides are found in concentrations of more than 75% of the drinking water standard (potentially problematic substances) at 2 surface water extraction sites and 1 riverbank filtration water extraction site (Van Driezum et al., 2020).

2.2.3 Groundwater

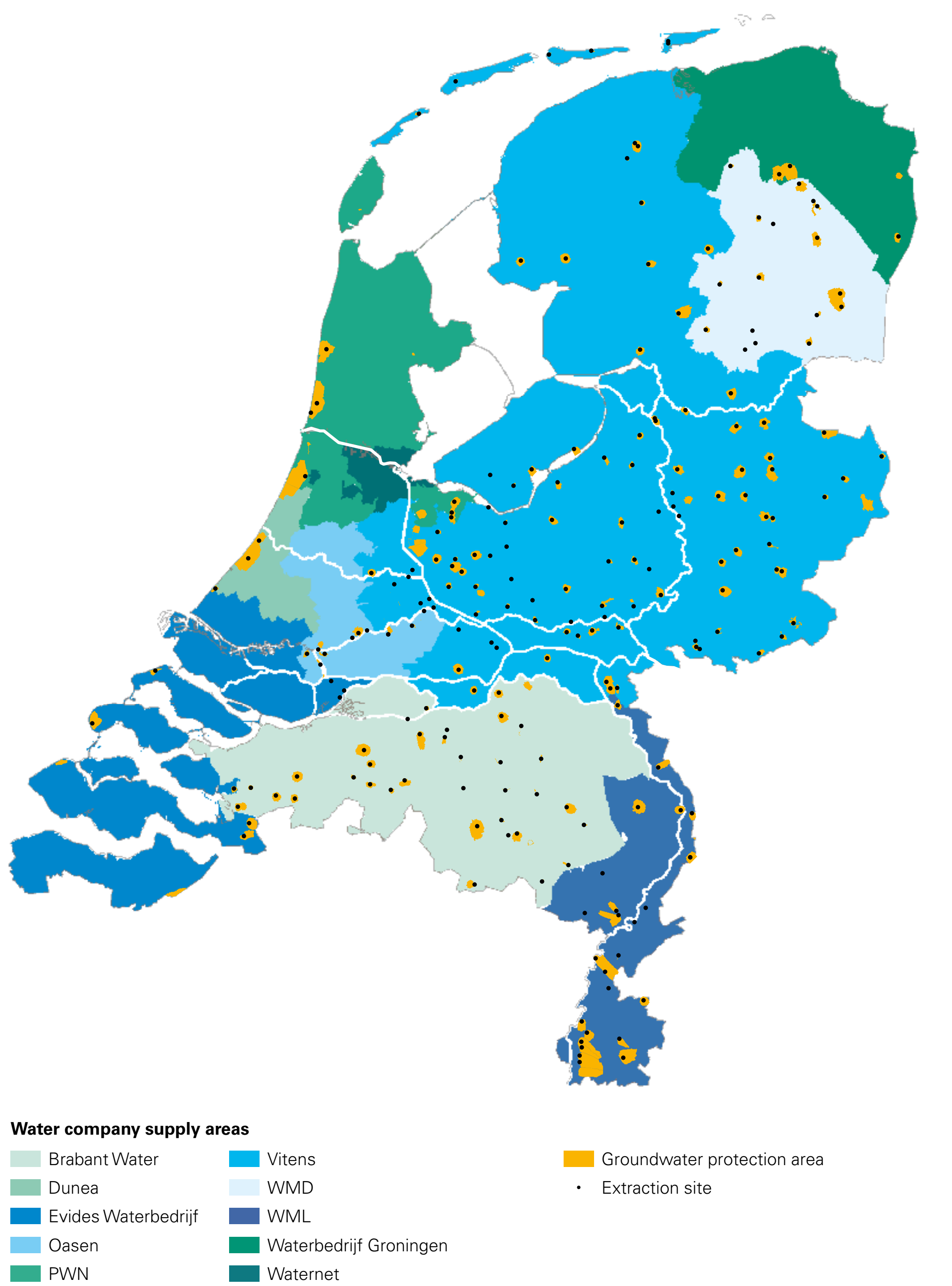
2.2.3.1 Protection of groundwater intended for drinking water production

About 66% of our drinking water is prepared from (riverbank) groundwater. This is divided as follows; 59% groundwater, 1% natural dune water and 6% riverbank filtration water. Outside the western part of the Netherlands, groundwater is the main source of drinking water.

The protection of groundwater intended for the production of drinking water is laid down in the Environmental Management Act, which is incorporated into the Environment and Planning Act. This regulates that provinces can designate protection areas around extraction sites. Activities within water extraction areas, groundwater protection areas and drilling-free zones are subject to rules that are set out in Provincial Environmental Regulations.

A water extraction area is a zone immediately around the drinking water extraction wells. It takes 60 to 100 days for water from the edge of this area to reach the extraction well. Only activities related to the public drinking water supply are allowed in this zone. Groundwater protection areas are located around water extraction areas in which other activities may take place to only a limited extent. It takes twenty-five years from the outer edge of the area for groundwater to reach the extraction well. A drilling-free zone is located as a shell around the groundwater protection area (or, if there is none, around the water extraction area). In drilling-free zones, drilling through the sealing layer of clay, which is located above the groundwater stratum that is used for drinking water production, is not allowed, or only under strict conditions.

Figure 2.12 Groundwater protection areas 2021



(KWR, 2021)

The location of the groundwater protection areas is shown in Figure 2.12. The total number of hectares of groundwater protection area in the Netherlands in 2020 is 100,979. Of this number, 12% (12,008 ha) is exclusively designated for water extraction.

2.2.3.2 Groundwater quality

Human activities cause the groundwater to be polluted to ever greater depths with many different substances. Due to the long residence time of groundwater in the soil, it is often too late when such pollution is detected. This is called ageing of the groundwater. To prevent this, it is important to implement a preventive policy (Van Gaalen et al., 2020).

Trend analysis of known problematic substances

RIVM has carried out a trend assessment of the water quality at groundwater extraction sites for drinking water production over the period 2000 - 2018 (Wit et al., 2020). The data for this originate from the Register Water Quality Companies (REWAB). For each extraction site it was investigated whether the average groundwater quality meets the standards from the Drinking Water Decree, which substances were found and what the trends and developments have been over the years. The extraction sites for which a trend has been demonstrated for known problematic substances are shown in Figure 2.13. An increasing trend has been demonstrated for 15 already known problematic substances and a decreasing trend for 12 . The trend analysis shows that the main problematic substances are pesticides, solvents and other industrial substances (Wit et al., 2020). The trend analysis for emerging substances is discussed under the heading 'Emerging substances' and is shown in Figure 2.17.

Chloride

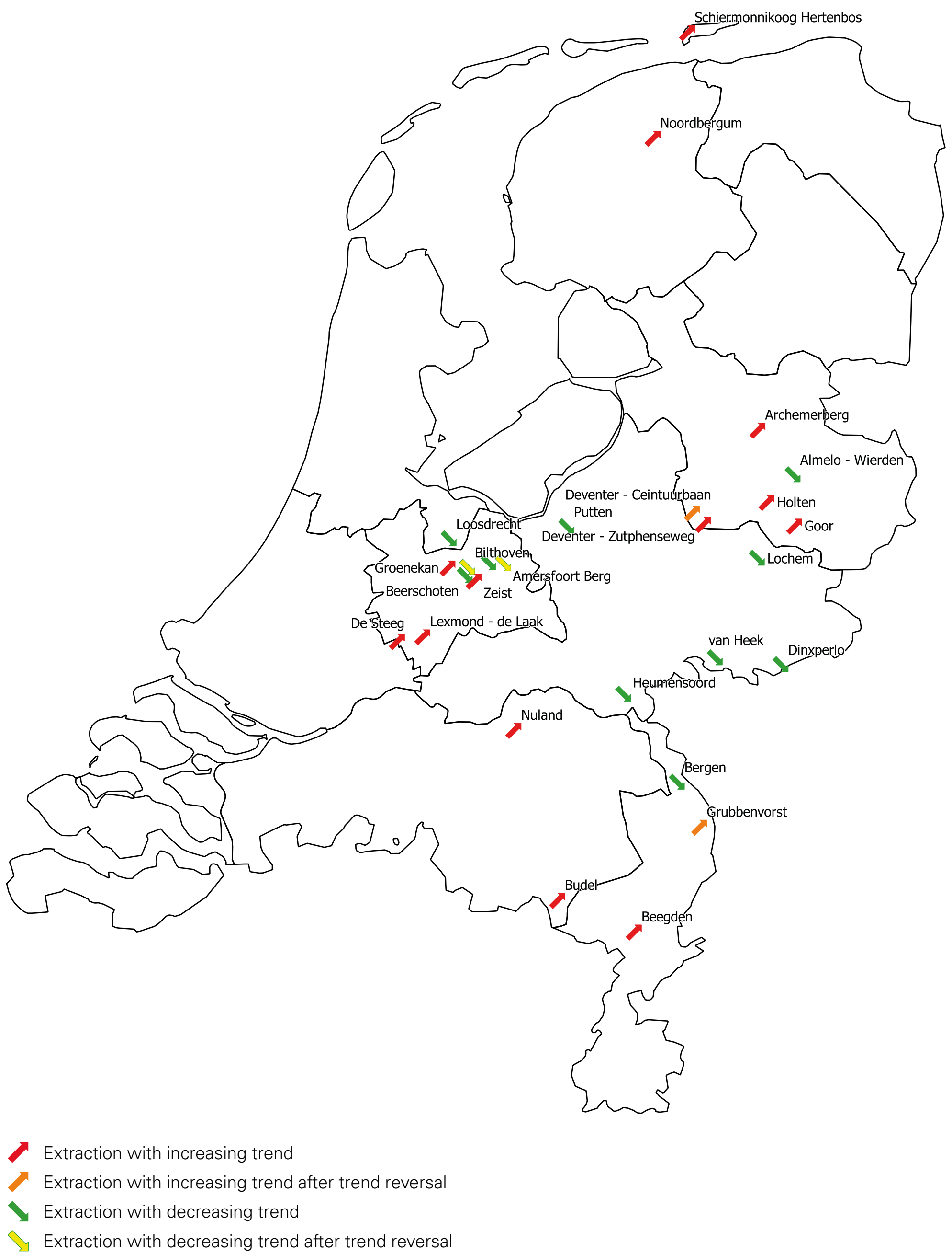
Figure 2.14 provides an overview of the extraction sites for drinking water production where chloride is a (potential) problematic substance. At 12 of the 215 inventoried extraction sites, the abstracted water exceeds the chloride standard of 150 mg/l. This concerns 10 groundwater extraction sites, 1 riverbank filtration water extraction site and 1 surface water extraction site (Andijk). At 7 extraction sites, the chloride concentration is higher than 75% of the drinking water standard and is a potentially problematic substance (RIVM, 2021).

Fertilisers

Fertilizers are a problem at surface water extraction sites (especially phosphorus, see § 2.2.2.2), but even more so at groundwater extraction sites. Nitrogen is the main problem at groundwater extraction sites. Nitrogen is one of the hazardous substances in drinking water production. It mainly occurs at groundwater extraction sites with an agricultural intake area, due to fertilisation. Fertilisation leads to increased nitrate concentrations and partly as a result of that (depending on the properties of the subsoil) to increased concentrations of sulphate and metals such as nickel (Van Driezum et al., 2020).

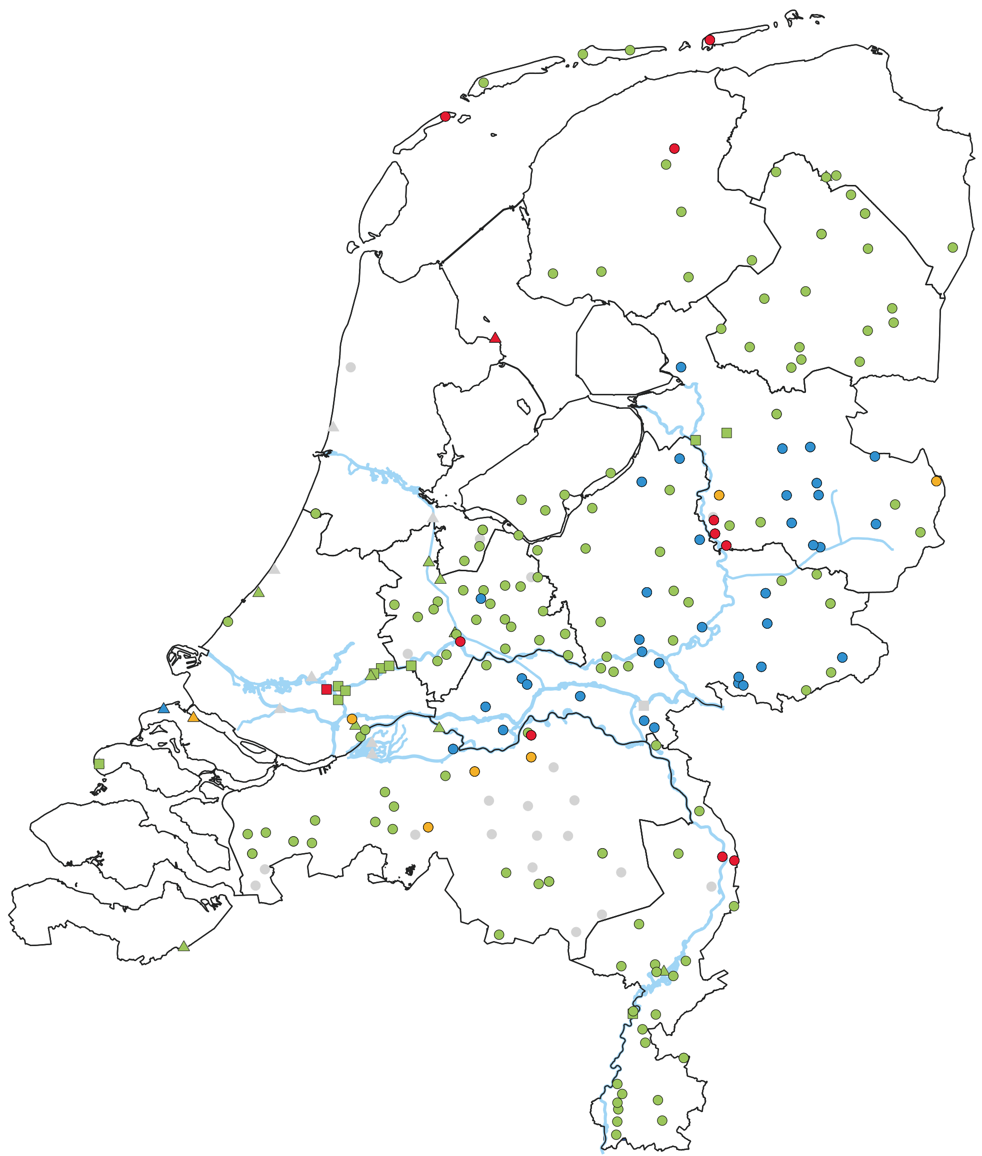
The report "The quality of drinking water sources in the Netherlands" (KWR, 2019) shows that, despite the decline in the use of nitrogen in the agricultural sector since 1990, overfertilisation is a current and large-scale problem for drinking water companies in the south and east of the Netherlands. Due to poor groundwater quality, partly as a result of manure disposal, a number of groundwater extraction sites in the province of Brabant, among others, have been closed or modified (KWR, 2016).

Figure 2.13 Extraction sites where a trend for known problematic substances has been demonstrated in the period 2000-2018



(Wit et al. 2020)

Figure 2.14 Chloride in drinking water sources



Problematic substance categories

- Current problematic substance found in extraction site
- Potential problematic substance found in extraction site
- Current problematic substance found in the observation wells
- No problematic substances found
- No area dossier

Type of extraction

- Groundwater
- Riverbank filtration water
- Surface water

(RIVM, 2021)

The 2018 area dossiers show that nitrate, nickel and sulphate are current or potentially problematic substances at 35 different groundwater extraction sites (Figure 2.15). Where manure-related problematic substances have been reduced at 3 extraction sites in the province of Gelderland, an increase in sulphate has been reported at 2 extraction sites in the province of Drenthe and 5 in Brabant (Van Driezum et al, 2020).

Pesticides

Pesticides are not only a problem at surface water extraction sites (see § 2.2.2.2), but also at groundwater extraction sites. Pesticides, often used in agriculture and public spaces, can wash away through the soil and eventually reach the groundwater. RIVM recently investigated the current environmental load of pesticides in groundwater at drinking water extraction sites. Pesticides were measured as a current problematic substance at 50 groundwater extraction sites and at 13 groundwater extraction sites, pesticides were found in concentrations of more than 75% of the drinking water standard (see Figure 2.11) (Van Driezum et al., 2020). In addition, pesticides are also observed as a problematic substance at 23 extraction sites in observation wells. Issues involving pesticides mainly occur in phreatic groundwater extraction sites (extraction sites without a sealing top layer) (25%) and to a lesser extent at groundwater extraction sites below a sealing soil layer (9%) (Van Driezum et al., 2020).

Soil-related contaminants

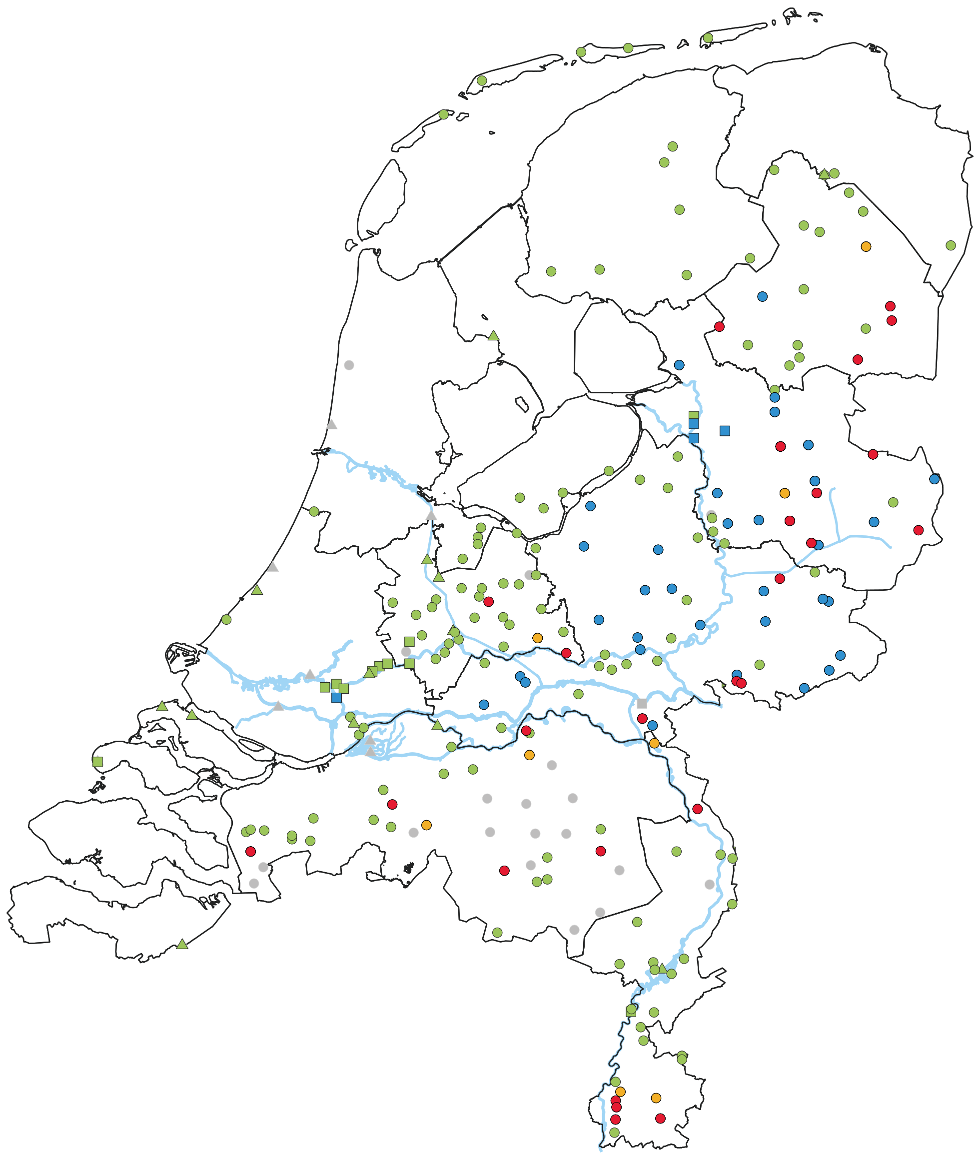
Figure 2.16 shows at which drinking water extraction sites soil-related contaminants (old soil contaminants) form a (potentially) problematic substance. At 54 of the 216 extraction sites, it appears that the abstracted water exceeds the standard from the Drinking Water Decree for one or more substances that presumably originate from soil-related contaminants. This is the case at 38 groundwater extraction sites. At another 19 groundwater extraction sites substances are found in concentrations of more than 75% of the drinking water standard (potentially problematic substances). (Van Driezum et al., 2020)

Emerging substances

The area dossiers examined by RIVM show that emerging substances are found in 57 of the 189 groundwater extraction sites investigated (Figure 2.10) (Van Driezum et al.). This is an increase compared to the number in the previous generation of area dossiers. This mainly concerns solvents, nutrients and pharmaceuticals. The increase in the number of emerging substances found can partly be explained by greatly improved analytical methods and the increased measurement efforts by the drinking water companies.

The trend assessment carried out by RIVM of the water quality at groundwater extraction sites for drinking water production over the period 2000 - 2018 shows 8 increasing and 8 decreasing trends for emerging substances (Figure 2.17) (Wit et al., 2020).

Figure 2.15 Manure-related problematic substances at groundwater extraction sites

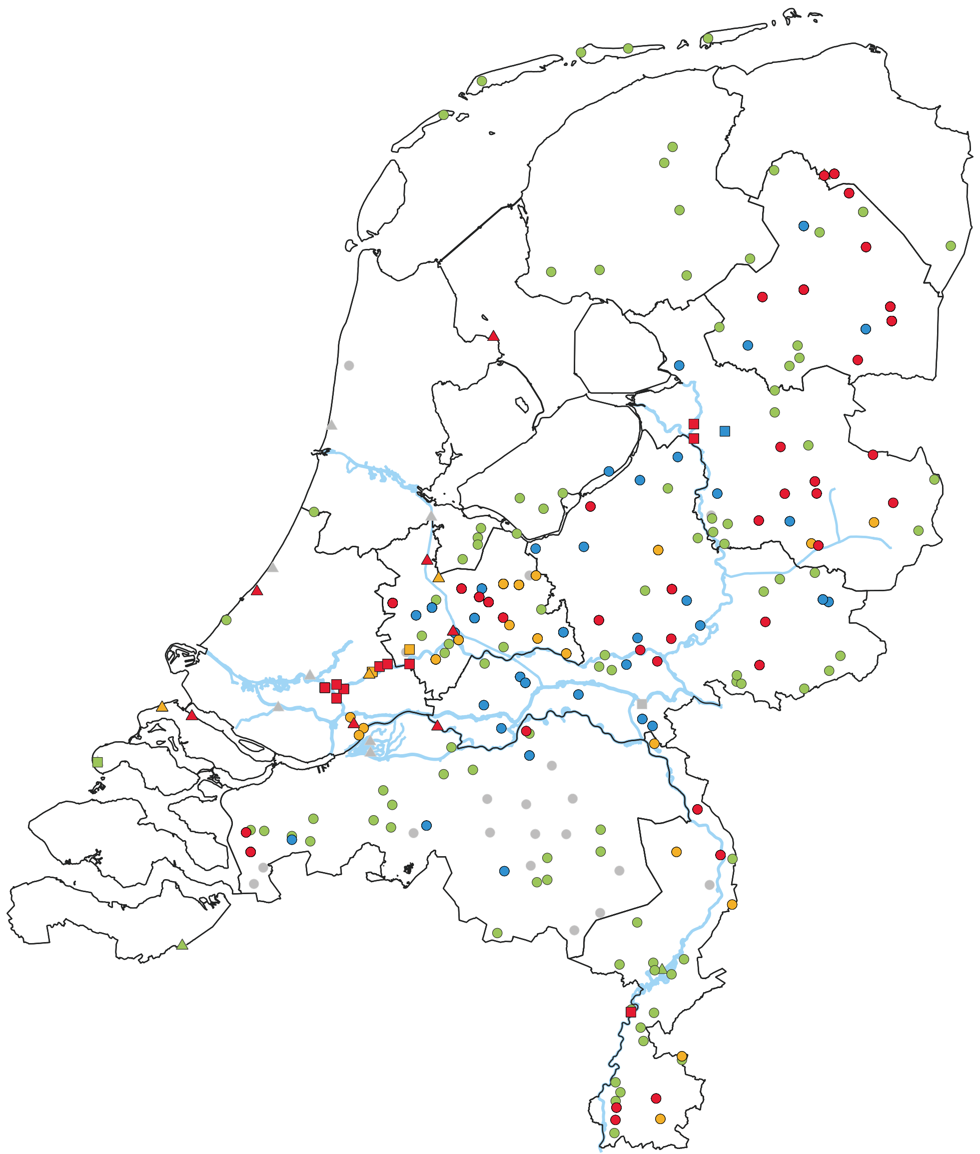


Problematic substance categories
- Current problematic substance found in extraction site
- Potential problematic substance found in extraction site
- Current problematic substance found in the observation wells
- No problematic substances found
- No area dossier

Type of extraction
- Groundwater
- Riverbank filtration water
- Surface water

(Van Driezum et al., 2020)

Figure 2.16 Soil-related problematic substances in drinking water sources

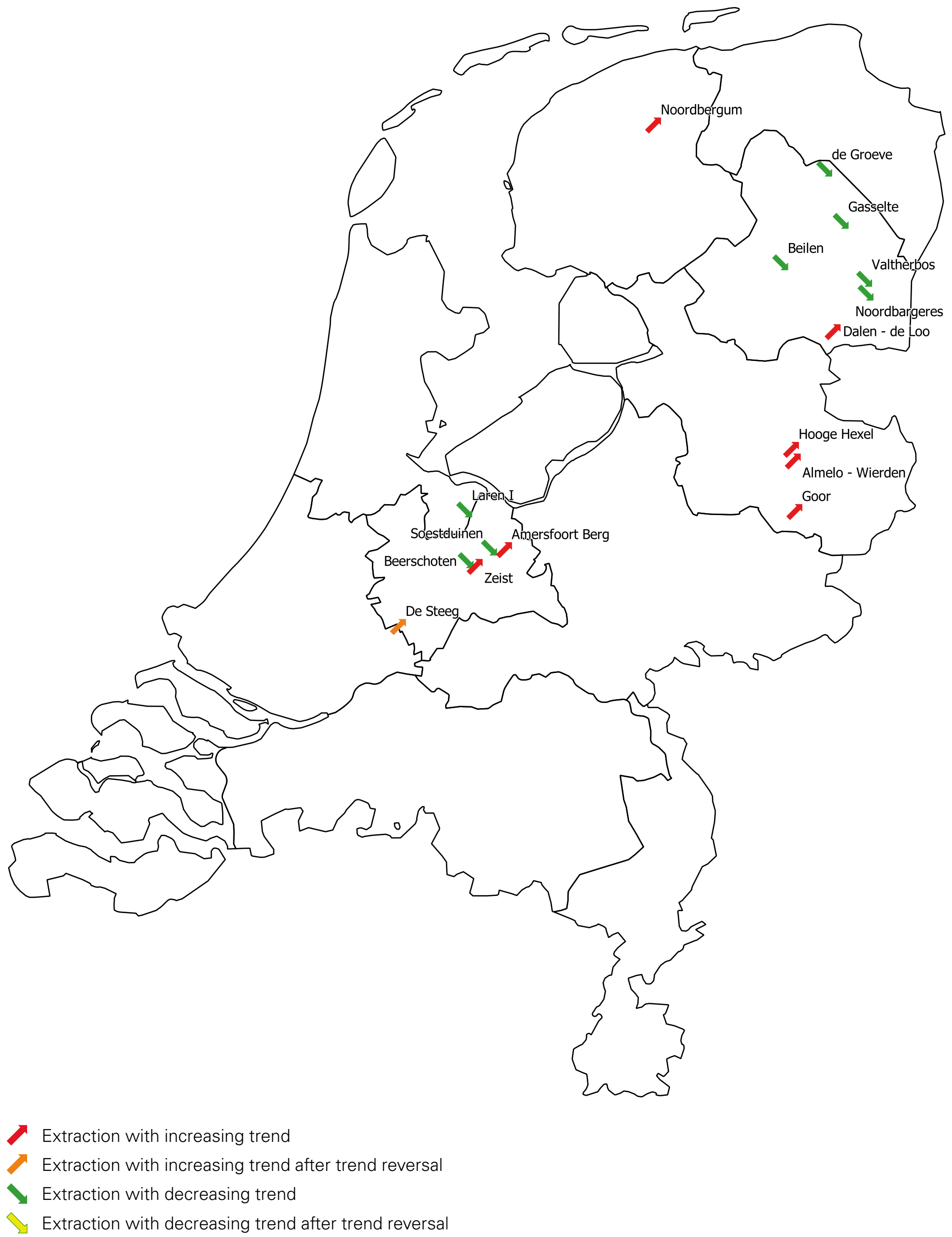


Problematic substance categories
- Current problematic substance found in extraction site
- Potential problematic substance found in extraction site
- Current problematic substance found in the observation wells
- No problematic substances found
- No area dossier

Type of extraction
- Groundwater
- Riverbank filtration water
- Surface water

(Van Driezum et al., 2020)

Figure 2.17 Extraction sites where a trend for emerging substances has been demonstrated in the period 2000-2018

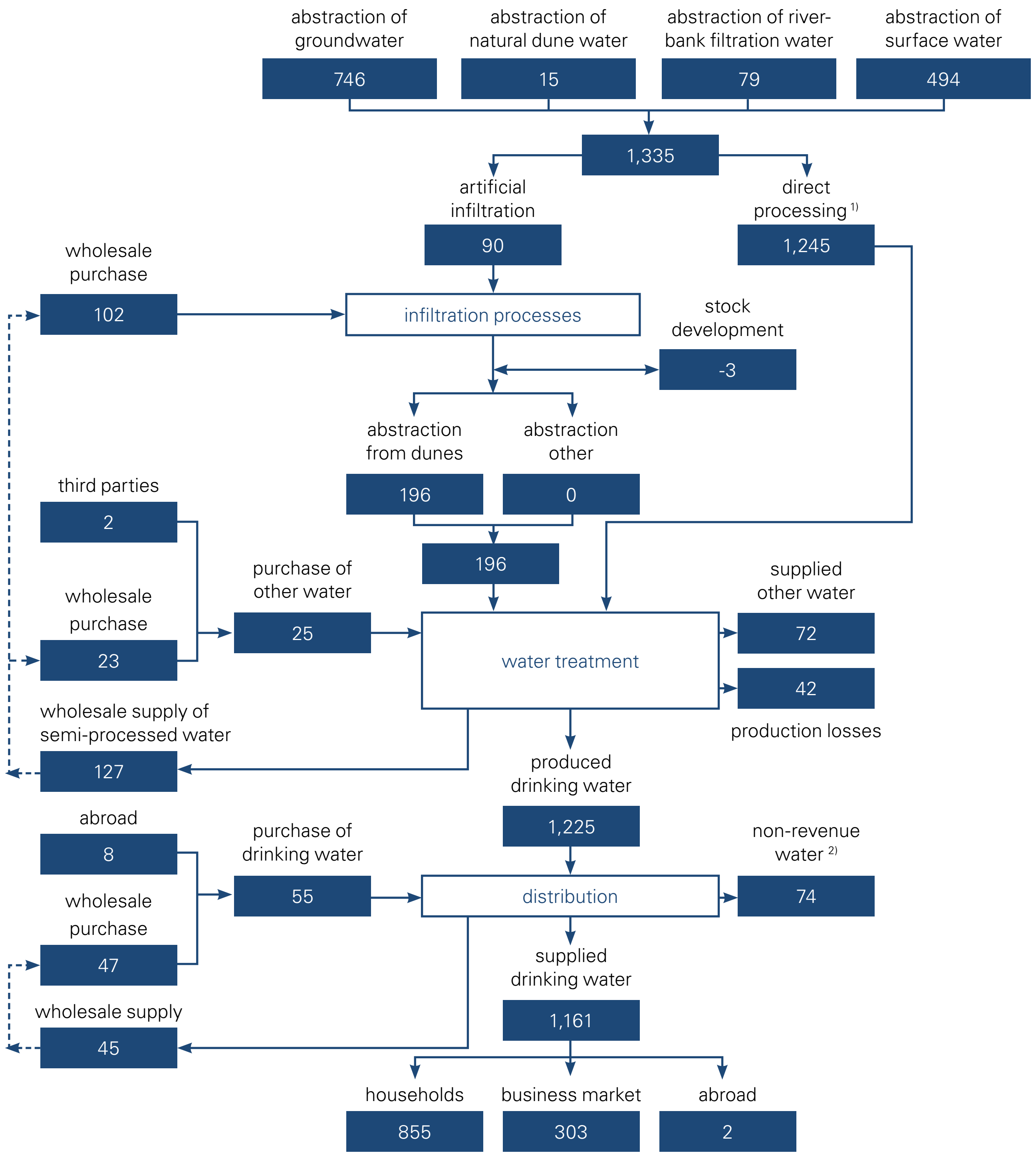


(Wit et al. 2020)

3 Drinking water supply

The previous chapter explained the availability and quality of water resources in the Dutch water system, while this chapter discusses the quantities of water that the drinking water sector abstract from it for drinking water preparation (§ 3.1 and § 3.2), how much drinking water is produced from it (§ 3.3) and what the customer uses it for (§ 3.5). In addition, § 3.4 contains information about the mains network through which drinking water is distributed to customers. In § 3.6, we discuss the financial aspects of the drinking water supply, such as the water rate, the required investments and the tax burden.

Figure 3.1 Water balance for drinking water and other water in 2020 (in million m³)



1) 102 million m³ is still infiltrated after wholesale supply. Therefore, the sector as a whole directly processed (1,245 – 102 =) 1,143 million m³ and infiltrated (90 + 102 =) 192 million m³.

2) Leakage, cleaning losses (flushing pipework), unbilled consumption (e.g. for fire extinguishing) and measuring differences.

3.1 Water balance of the drinking water sector

Figure 3.1 shows the water balance for 2020. The balance sheet shows the quantities of water extracted, produced and delivered by the drinking water sector. Water extraction is shown per type of source (groundwater, natural dune water, riverbank filtration water and surface water) and by processing method (artificial infiltration and direct processing). The deliveries are subdivided into final deliveries to households and the business market and mutual deliveries between drinking water companies (wholesale supply). The deliveries of WRK to the drinking water companies are included as wholesale supplies. WBB, on the other hand, has been included as part of Evides. Other water (see § 3.3.2) is only included in the water balance insofar as it is produced and supplied by the drinking water companies (excluding their subsidiaries and sister companies) and by WRK.

3.2 Water extraction

The total amount of water extracted by the sector in 2020 is stated per type of source at the top of the water balance. These quantities are specified per water company in Table 3.1.

The total water extraction in 2020 amounts to 1,335 million m³, which is 118 million m³ more than 10 years ago (+9.7%). Compared to 2019, water extraction has increased by 33 million m³ (+2.5%). The increase is in relation to the increasing demand for drinking water since 2015 (§ 3.5.2).

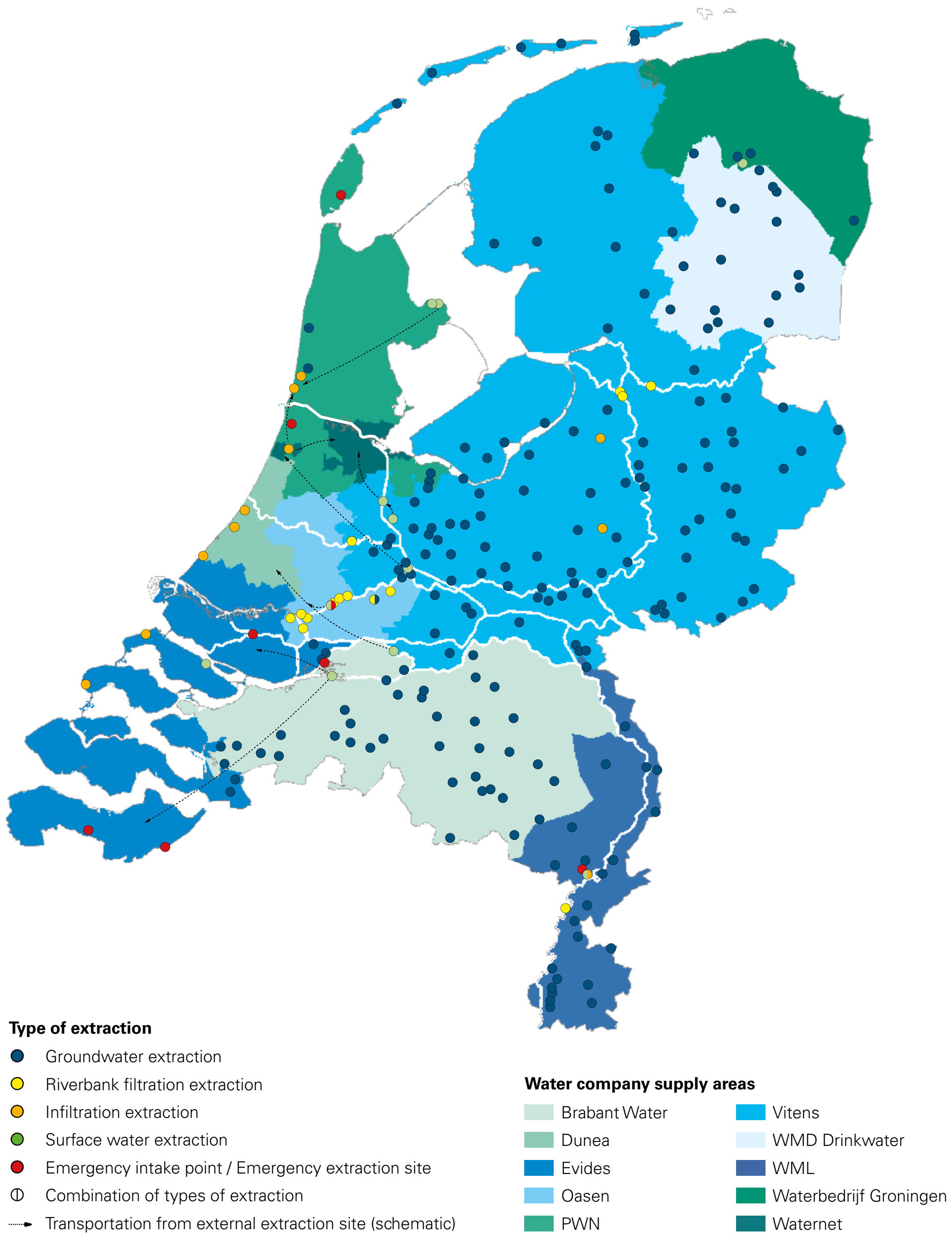
Figure 3.2 shows the extraction locations for the production of drinking water. Some extraction sites are located in the distribution area of another drinking water company. For example, two Waternet surface water extraction sites are located in Vitens' distribution area. A dotted line is used as a schematic reference to indicate to which drinking water company the extraction site belongs and where the extracted water is transported to.

Table 3.1 Water extraction in 2020 (million m³)

	Total	Groundwater	Riverbank filtration water	Natural dune water	Surface water
Brabant Water	206	206	-	-	-
Dunea	82	-	-	-	82
Evides Waterbedrijf 1)	209	17	-	1	191
Oasen	47	6	41	-	-
PWN	39	5	-	2	31
Vitens	394	381	13	-	-
Waternet	37	-	-	12	25
Waterbedrijf Groningen	47	40	-	-	7
WMD Drinkwater	37	37	-	-	-
WML	78	54	25	-	-
WRK	158	-	-	-	158
The Netherlands	1,335	746	79	15	494

1) Including Waterwinningsbedrijf Brabantse Biesbosch.

Figure 3.2 Extraction sites for the production of drinking water, 2021

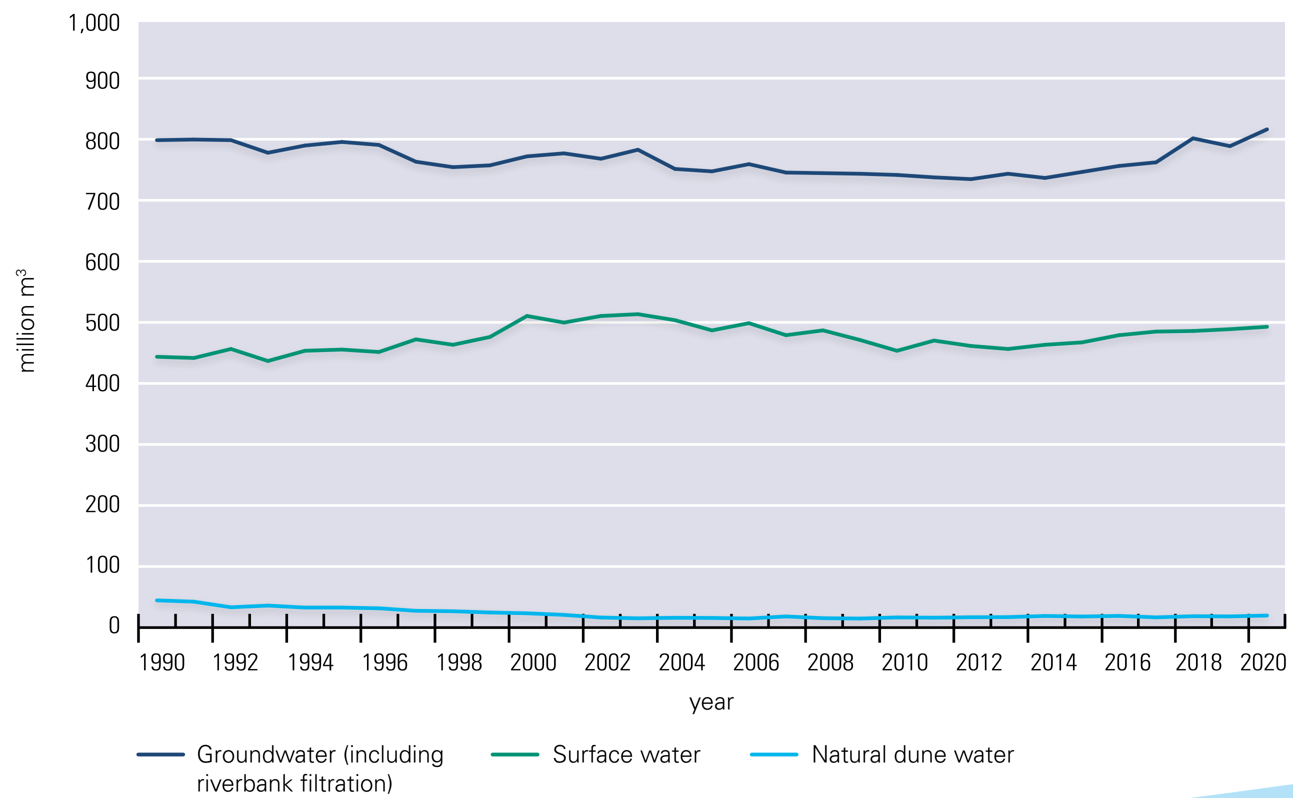


(KWR, 2021)

There are also mixed forms of extraction, for example at Heel, in the distribution area of WML. These mixed forms are shown in two colours. The map also shows the emergency intake points/emergency extraction sites. There are a total of 225 extraction sites (excluding emergency extraction sites), of which 2 sites have a mixed form. If we include the mixed forms in both categories, the totals per type come to: 192 groundwater extraction sites, 10 surface water extraction sites, 14 riverbank filtration water extraction sites and 11 infiltration extraction sites.

Figure 3.3 shows a time series of water extraction by type of source. Between 1990 and 2000, the percentage share of surface water in the total volume of extraction increased from 34 to 39%, while the share of (riverbank) groundwater including natural dune water decreased from 66 to 61%. Between 2000 and 2008, the share of surface water remained practically constant at 39%. In 2009, the share of surface water fell to 38% and the share of (riverbank) groundwater, including natural dune water, rose to 62%. The ratio has remained virtually the same since, with the exception of 2018 and 2020, which were characterised by exceptionally high drinking water use. In these two years, the share of surface water was slightly lower (37%) and the share of (riverbank) groundwater, including natural dune water, was somewhat higher (63%).

Figure 3.3 Development of water extraction by source



3.3 Production

3.3.1 Production of drinking water

Part of the extracted water shown in Figure 3.1 is used for the production of 'other water' (§ 3.3.2). In addition to own water extraction, the production processes use a small part of purchased (other) water. To find out how much water per type of source is used specifically for the production of drinking water, the companies were asked what the type of source was for the other water. The quantities shown per source in Figure 3.1 were then corrected for the quantities per type of source for other water. The result is shown in Figure 3.4.

This shows that, in 2020, a total of 34% of surface water was used for the production of drinking water and 66% of groundwater and riverbank filtration water, including natural dune water (59% groundwater, 6% riverbank filtration water and 1% natural dune water).

Table 1.3 (§ 1.1) shows the quantities of drinking water produced per company in 2020. Together, the sector produced 1,225 million m³ of drinking water, 89 million m³ more than ten years ago in 2010 (+7.8%) and no less than 26 million m³ more than in the peak year of 2018 (+2.1%). Compared to 2019, production increased by 38 million m³ (+3.2%). The increase is a direct result of the extra strong demand for drinking water in 2020 (§ 3.5.2). The development in production volume since 1950 is shown in Figure 3.5.

3.3.2 Production of other water

Other water is water that is not of drinking water quality. This usually concerns applications for which less extensive treatment suffices (for example, process water), but it can also concern specific applications for which more extensive treatment is required (for example, demineralised water). As indicated in the water balance (Figure 3.1), the sector (including WRK) supplied

Figure 3.4 Sources used for drinking water 2020 (in million m³)

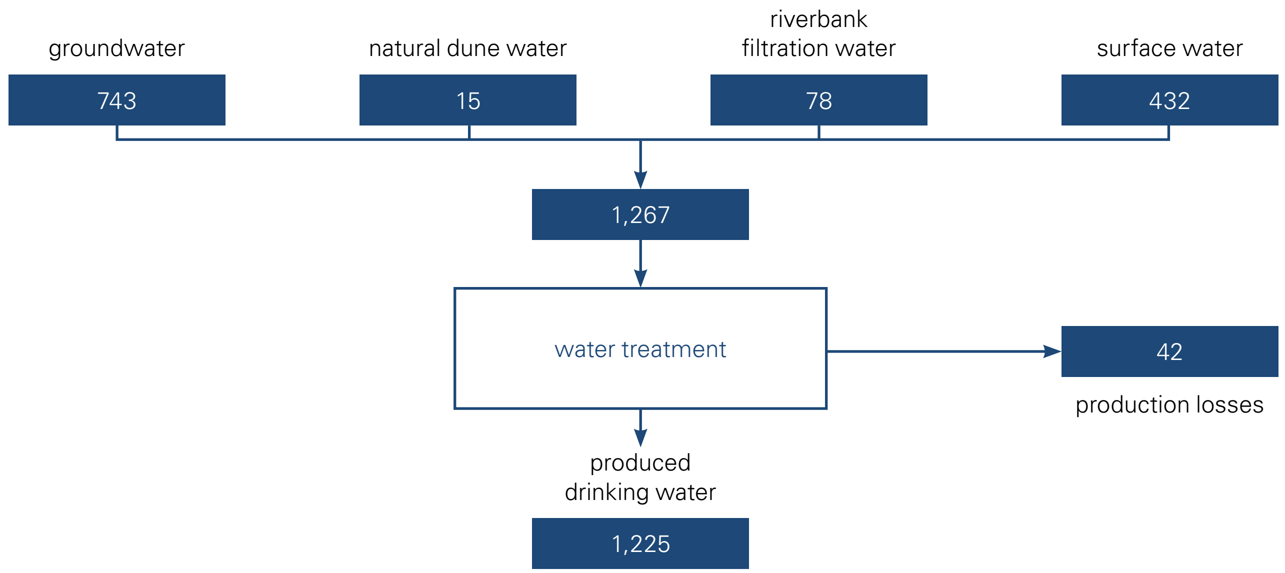
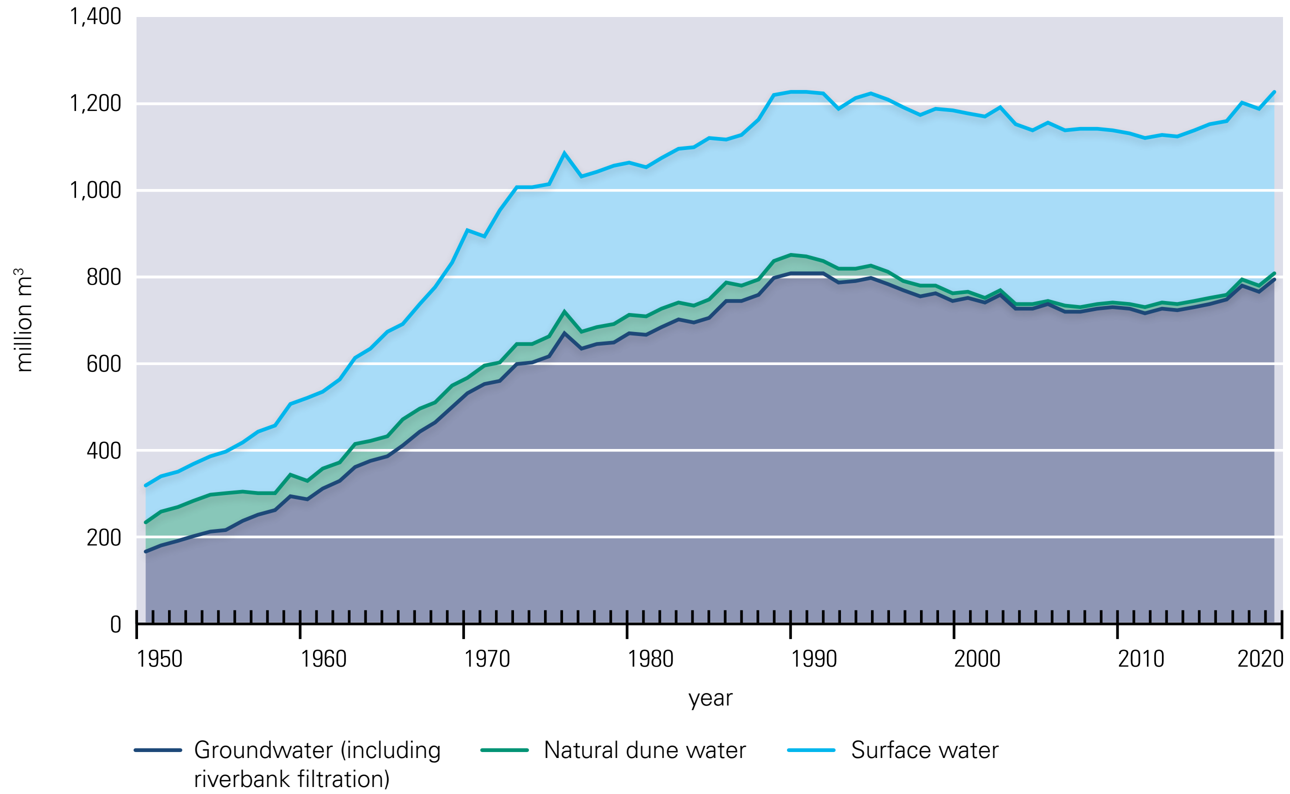


Figure 3.5 Development of drinking water production by source



72 million m³ of other water in 2020. This quantity mainly consists of supplies from WRK to industrial customers and the supply from Evides drinking water company to its industrial water division.

In addition, but not included in the water balance, other water is supplied by subsidiaries and sister companies specifically focused on other water. In 2020, this group of companies produced approximately 61 million m³ for the Dutch market. This excludes water that is produced in plants that are managed and operated on behalf of the customer, which does in fact not involve any water supplies.

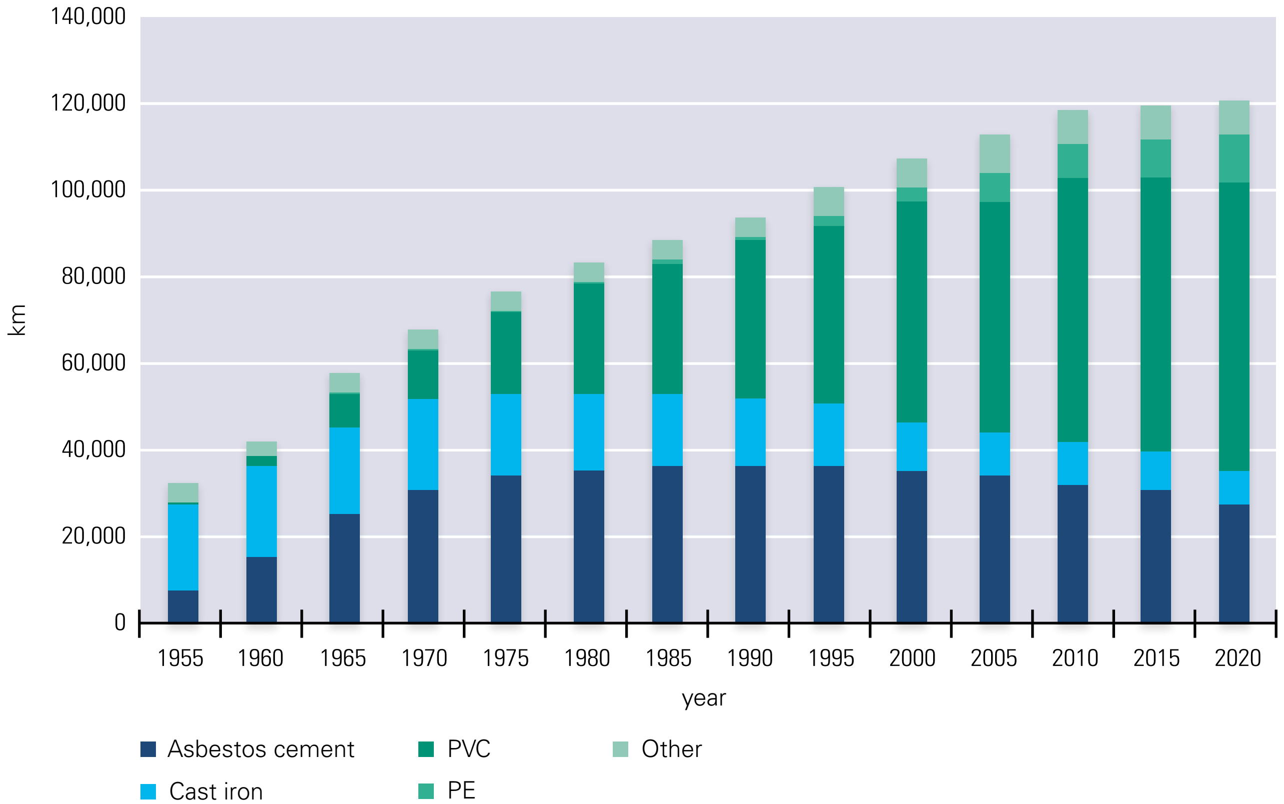
3.4 Water distribution

Table 3.2 provides an overview of the length and composition of the drinking water supply network as at 31 December 2020. The total network consists of more than 120,000 km of pipeline. The development of network lengths for the most commonly used materials is shown in Figure 3.6. This figure clearly shows the increase in the use of polyvinyl chloride (PVC) and polyethylene (PE). At present, more than half (54.5%) of the water mains consists of PVC. At the same time, network lengths for the materials 'asbestos cement' and 'cast iron' are gradually decreasing.

Table 3.2 Length and composition of the 2020 transport and distribution network (kilometres)

	Total	PVC	Asbestos cement	Polythene (PE)	Cast iron	Ductile iron	Steel	Concrete	Other
Brabant Water	18,313	10,912	5,585	441	1,154	68	74	39	41
Dunea	4,954	2,979	566	404	617	253	35	91	10
Evides Waterbedrijf	12,465	7,345	2,627	1,361	323	10	726	21	52
Oasen	4,230	2,318	212	1,336	90	66	204	2	2
PWN	10,137	2,792	3,890	1,935	581	511	206	179	41
Vitens	48,427	29,592	8,753	5,729	3,626	124	182	81	340
Waternet	2,782	1,008	58	41	607	543	110	343	72
Waterbedrijf Groningen	5,261	2,428	1,590	156	875	0	164	21	27
WMD Drinkwater	4,869	3,803	700	236	-	129	0	-	-
WML	8,807	2,344	3,251	103	511	1,802	784	2	11
The Netherlands	120,244	65,522	27,231	11,743	8,384	3,506	2,484	780	595

Figure 3.6 Development of the drinking water supply network



3.5 Water sales and use

3.5.1 Sales and turnover 2020

Table 1.3 (§ 1.1) shows drinking water sales and drinking water turnover in 2020 per company. In addition, the water balance (§ 3.1) includes the sales of other water. Table 3.3 below provides a total overview of drinking water sales in 2020, broken down by household and business market user groups. Table 3.4 specifies the subdivision per drinking water company.

Table 3.3 Summary of drinking water sales for 2020

	Administrative connections [1]	Sales	Average supply	Turnover [2]	Average price [2]
		million m³	*m³/connection*	*million €*	*€/m³*
End users households	8,150,518	855	104.9	1,133	1.32
End users business market	223,117	303	1,360	263	0.87
Total end users	8,373,634	1,159	138	1,396	1.20
Wholesale	.	45	.	27	0.60
Export	.	2	.	.	.

1) Average number in 2020.

2) Comprises reimbursements for the variable rate, standing charges and/or charges for available capacity. Excluding tap water tax and VAT.

Table 3.4 Sales in supply areas by user group 2020 (million m³)

	Households	Business market	Total
Brabant Water	116	71	187
Dunea	66	11	77
Evides Waterbedrijf	111	47	158
Oasen	37	12	49
PWN	89	20	109
Vitens	283	80	363
Waternet	48	21	69
Waterbedrijf Groningen	26	20	46
WMD Drinkwater	25	5	30
WML	55	17	72
The Netherlands	855	303	1,159

3.5.2 Development of drinking water use

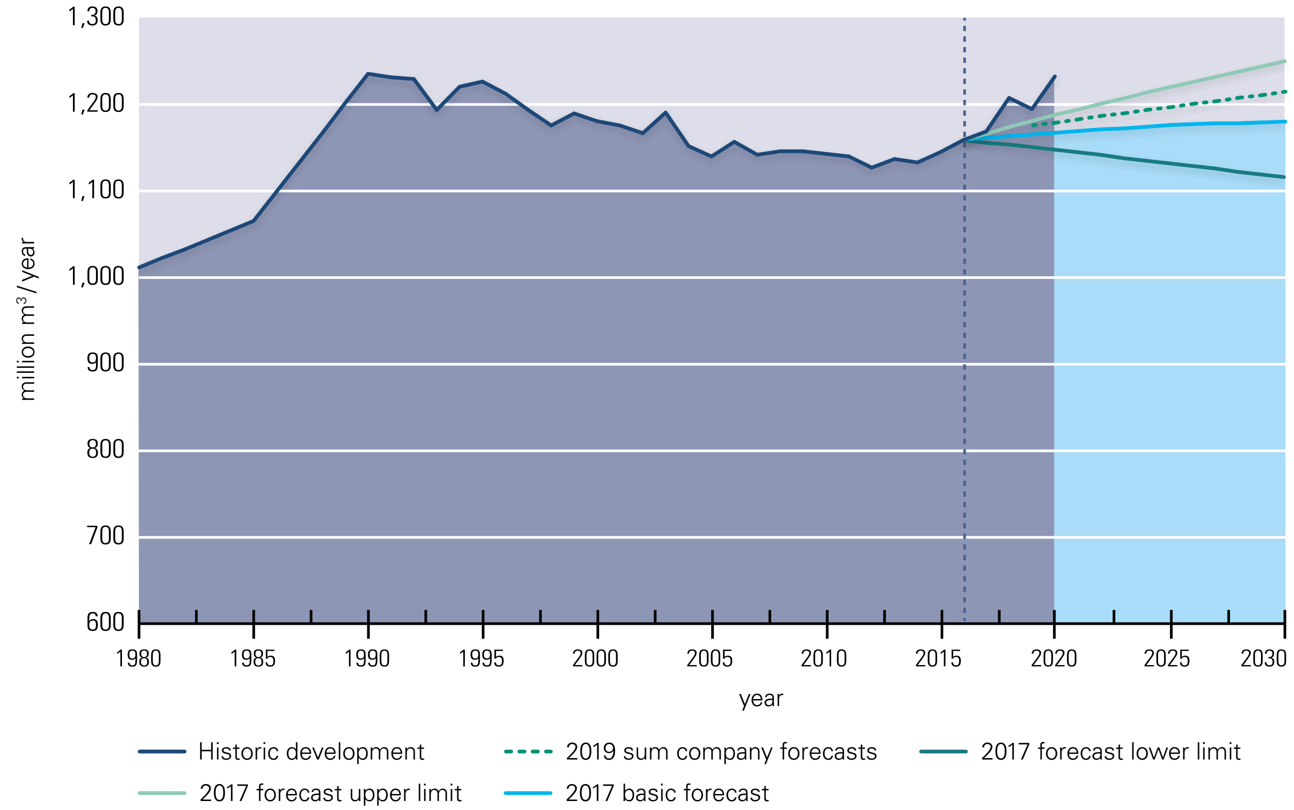
Figure 3.7 shows the development of total drinking water use since 1980. In addition to sales, use includes non-revenue water (NRW). This consists of actual leakage losses, internal use for cleaning pipes (flush losses), other unbilled use (e.g. fire extinguishing water and public taps), illegal tapping and measuring differences. In 2020, almost 6% of the total drinking water demand is NRW (74 million m³, see Figure 3.10). From a sustainability viewpoint, the Dutch companies aim to achieve the lowest possible NRW (§4.2.1).

In the last century, total drinking water use in the Netherlands increased strongly: from approx. 300 million m³ in 1950 to approx. 1,000 million m³ in 1980, rising further to a level of approx. 1,236 million m³ in the years 1990 - 1995. Thereafter, usage gradually fell over two decades, reaching 1,133 million m³ in 2014. Water use started to rise again from 2015 onwards, initially limited but then sharply, reaching 1,233 million m³ in 2020, nearly as much as in the record year of 1990. The growth from 2015 can be attributed to the increase in population and economic growth (until 2020), but also to the increase in use per household capita (Figure 3.12). In the years 2018, 2019 and 2020, the demand for water was driven up by three hot and dry summers in a row. In § 3.6.1, we will discuss the impact on water use due to the extreme heat and drought of 2018 in more detail.

In 2020, water demand is likely to have increased further due to the high precipitation deficit in spring while nature had not recovered yet from the drought in the previous two years, and due to the Covid-pandemic as of March 2020. Thereby a shift was observed from business to domestic use. Compared to 2019, total drinking water use increased by 3.2%, with business use falling by 1.9% and domestic use rising by 4.5%. Covid measures forced people to work and study from home for a large part of the year and they were not able to visit the sports club during that time. In addition, people had to wash their hands more often, went out less and tended to spend their holidays at home. Consequently, part of the water use (e.g. toilet and showering) shifted from business to domestic use. Domestic use was given an extra boost by holidays at home in combination with the very hot weather conditions (water in swimming pools, etc.). In addition, the number of inhabitants increased (+1.2% compared to 2018) and severe drought occurred in the growing season. This combination of factors explains why water use in 2020 (despite the economic downturn in 2020) was 2.0% higher compared to 2018, whereas 2018 as a whole was drier still (see Figure 2.4 and Table 2.3).

In addition to the historical drinking water use, Figure 3.7 shows drinking water demand that was forecast in 2017 (Icastat & Vewin, 2017) and the sum of individual company forecasts inventoried in 2019. The forecasts show an underestimation of the actual water use. The current increases in water use due to the heat and extreme drought in recent years and due to the Covid measures in 2020 could not be foreseen in 2017. Given the exceptional circumstances after 2017, it is too early to consider the 2017 sector forecast as outdated. It does seem, however, that a development towards the upper limit of the forecast from 2017 is more likely than a development according to the basic forecast.

Figure 3.7 History and forecast drinking water use (including NRW)



(Icastat & Vewin, 2017)

Figure 3.8 Development of drinking water sales to households

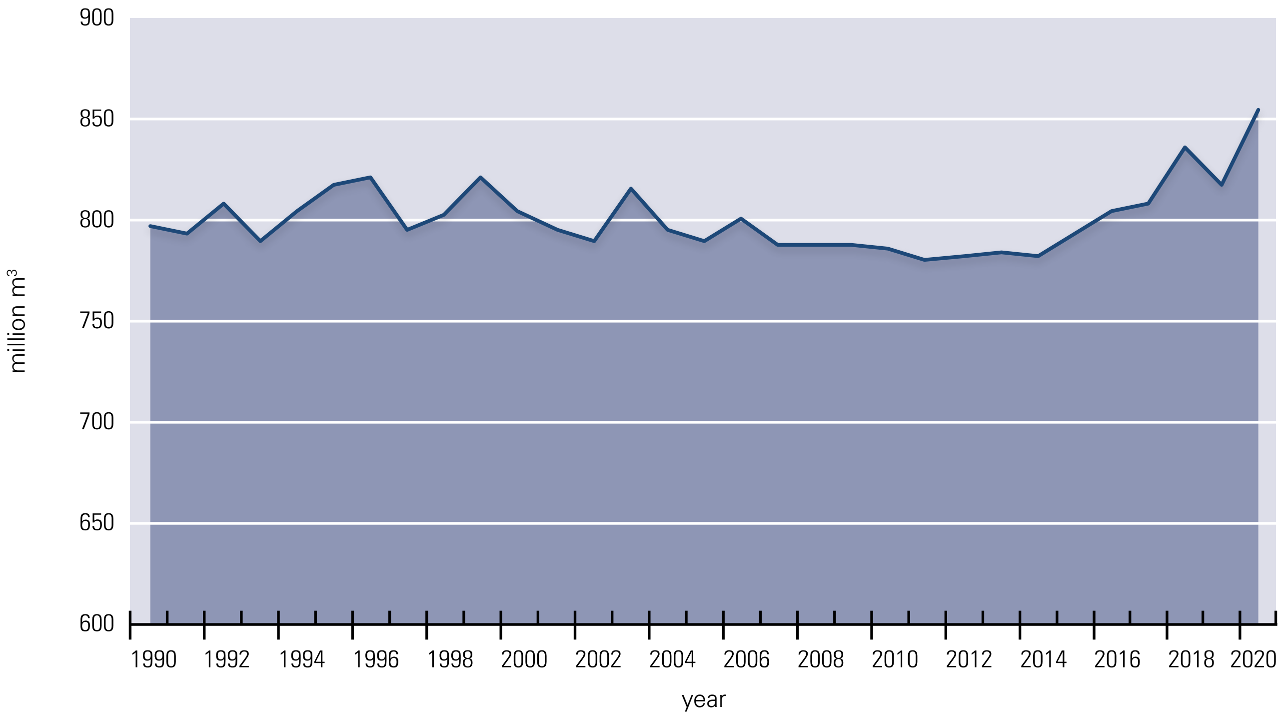


Figure 3.9 Development of drinking water sales to the business market

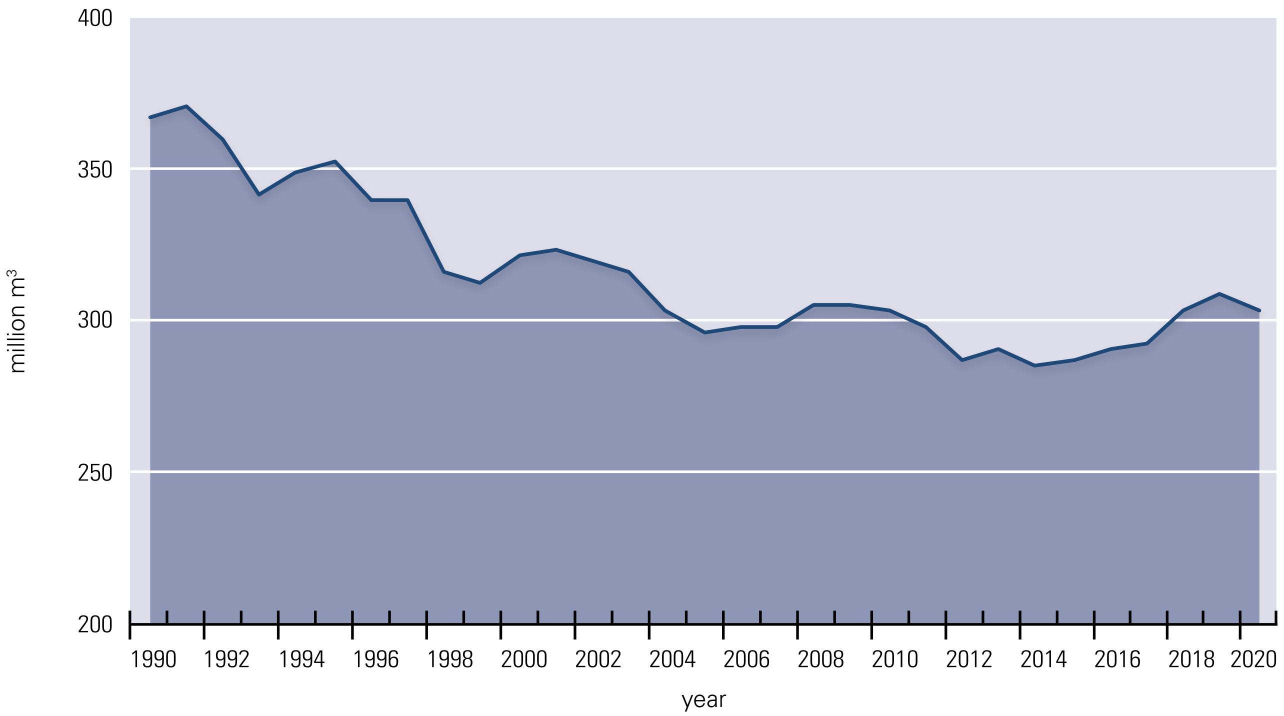
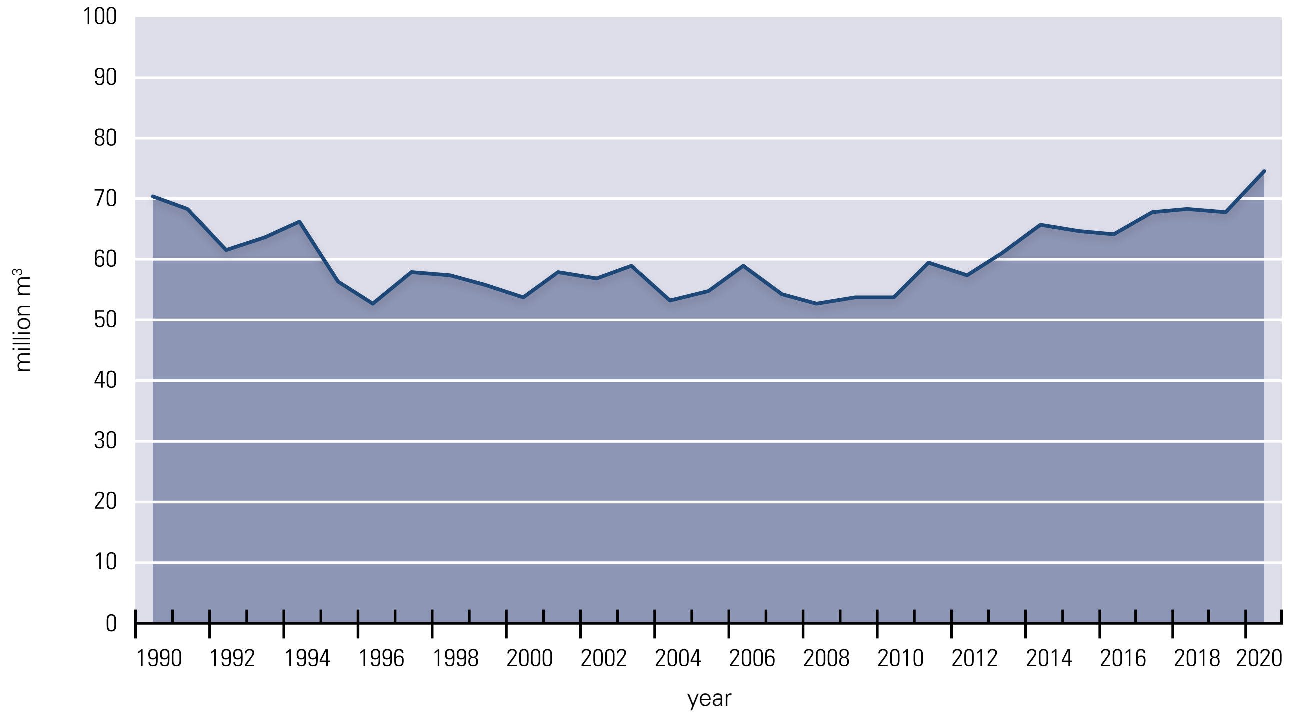


Figure 3.10 Development of non-revenue water



In Figures 3.8 to 3.10, the development of drinking water demand is broken down into the sub-uses households, business market[2] and NRW. The development of drinking water use by households and the business market is discussed in more detail below. NRW is discussed in more detail in § 4.2.1.

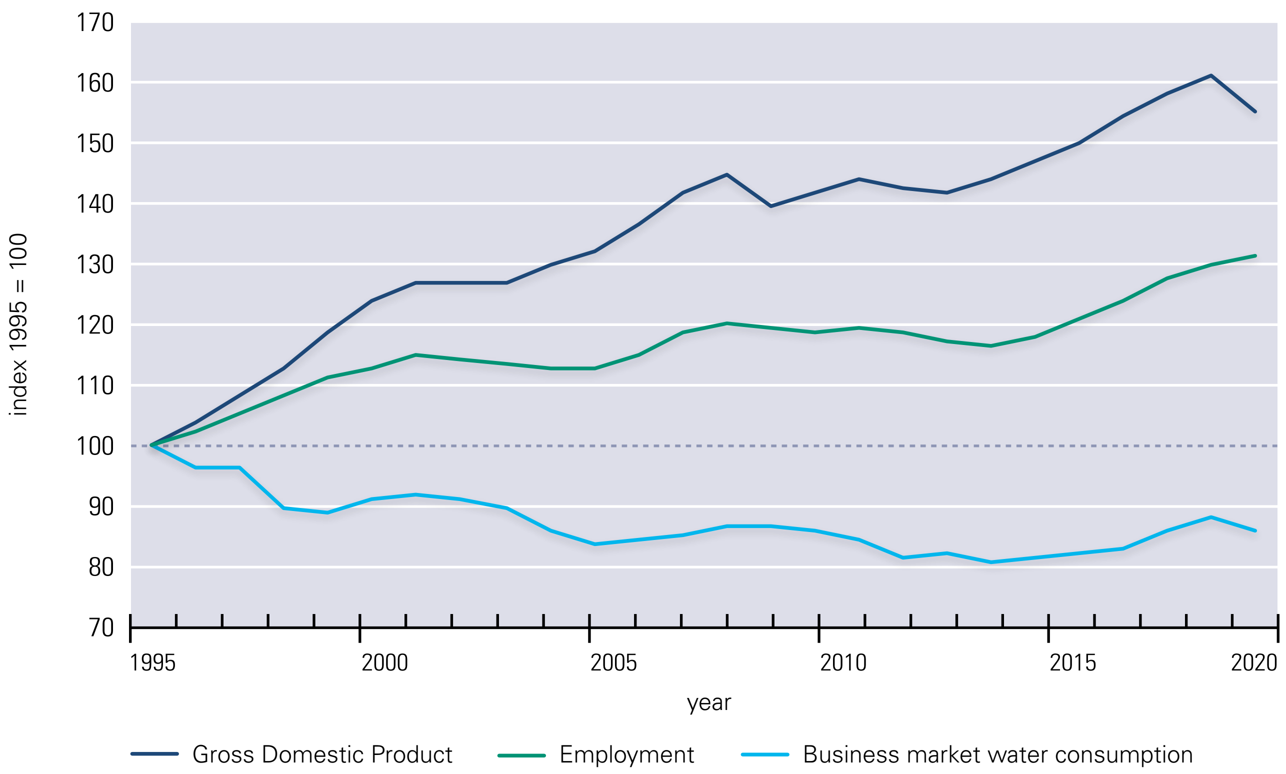
The figures show that the fall in water use between 1990 and 2014 mainly occurred in the business segment (-23%). Between 1995 and 2005, the fall was strongest in the business segment (-57 million m^3, -1.6% per year), despite strong growth in the economy and jobs during that period. This is clearly reflected in Figure 3.9. The causes of the sharp decline were water conservation, water reuse and substitution of drinking water by other water and private water extraction. After a slight increase between 2005 and 2010, sales in the business market fell again: from 303 million m^3 in 2010 to 285 million m^3 in 2014. This was partly due to the economic crisis that started in 2008 and lasted until about 2014, but is also related to an increased pursuit of water conservation and reuse as part of

2 *Figures 3.8 and 3.9 show the development of sales per user group since 1990; The figures up to 2007 are corrected data. The original time series showed a sharp decline for business use in 2007 and a sharp increase for domestic use. This shift was not an actual change, but the result of an administrative change at one of the companies in 2007, following a harmonisation effort in the registration of user groups. To restore comparability with previous years, the original time series (1990-2006) has been corrected for this as part of a collaboration project with Statistics Netherlands.*

a circular economy. The economic growth starting in 2015 meant that sales in the business market picked up again, to 309 million m³ in 2019. In 2020, however, this fell again to 303 million m³, because the economy was hit by the coronavirus crisis, which meant that everyone had to work and study from home as much as possible.

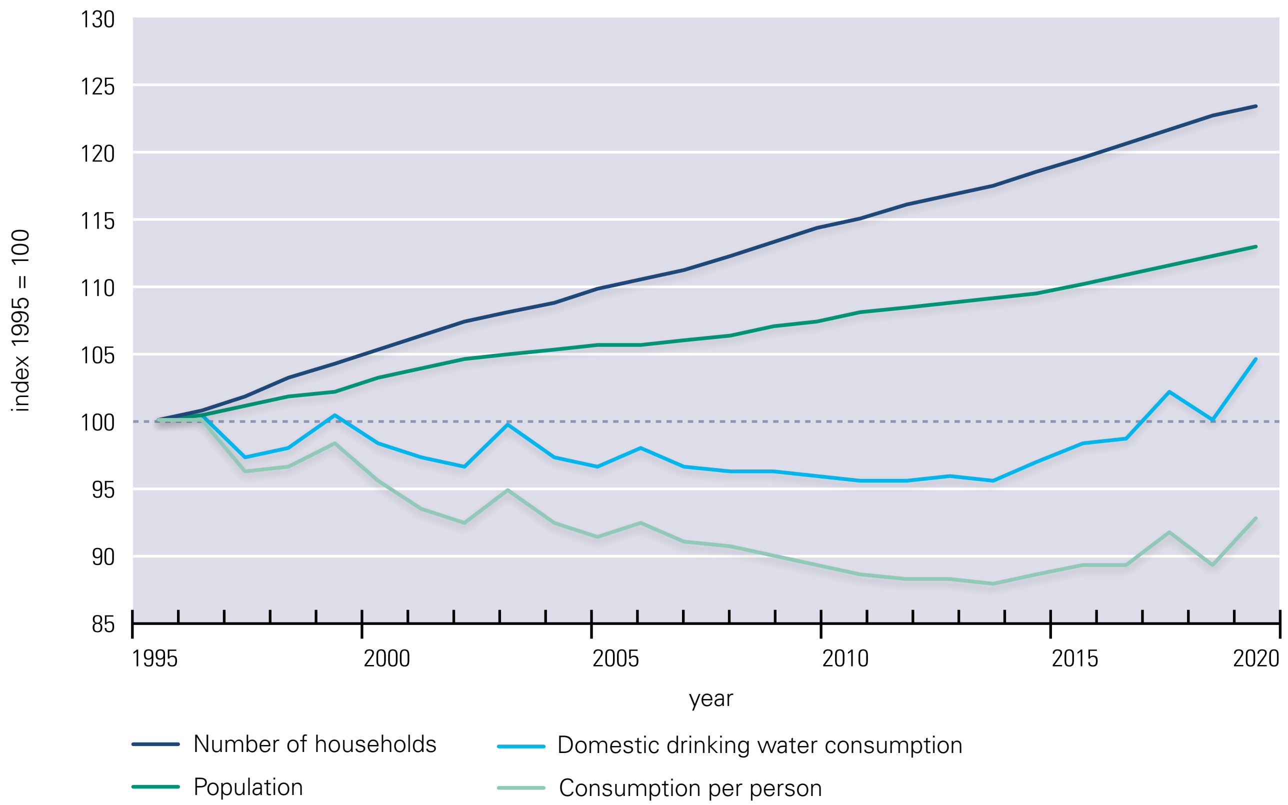
Between 1990 and 2014, domestic drinking water use decreased much less (-1.8%) than in the business market. The population grew during that period, but this was more than compensated by the fall in domestic water use per capita. However, this has changed since 2015. Since then, both the number of inhabitants and the domestic water use per capita are rising (Figure 3.12), resulting in an increase in sales to households. The increase in domestic water use per capita is exacerbated by the heat and drought in the period 2018 – 2020. As explained above, in 2020, the domestic water use per capita probably increased slightly due to people staying at home during the Covid pandemic in combination with the hot weather conditions.

Figure 3.11 Business market drinking water consumption vs. development of the economy



(Vewin / Statistics Netherlands, 2021)

Figure 3.12 Domestic drinking water consumption vs. population growth



(Vewin / Statistics Netherlands, 2021)

Table 3.5 Domestic drinking water by application 1995 – 2016 (litre per person per day)

	1995	1998	2001	2004	2007	2010	2013	2016
Bath	9.0	6.7	3.7	2.8	2.5	2.8	1.8	1.9
Shower	38.3	39.7	42.0	43.7	49.8	48.6	51.4	49.2
Washbasin	4.2	5.1	5.2	5.1	5.3	5.0	5.2	5.2
Toilet flush	42.0	40.2	39.3	35.8	37.1	33.7	33.8	34.6
Hand washing of laundry	2.1	2.1	1.8	1.5	1.7	1.1	1.4	1.3
Machine washing of laundry	25.5	23.2	22.8	18.0	15.5	14.3	14.3	14.1
Handwashing of dishes	4.9	3.8	3.6	3.9	3.8	3.1	3.6	3.5
Dishwasher	0.9	1.9	2.4	3.0	3.0	3.0	2.0	2.5
Food preparation	2.0	1.7	1.6	1.8	1.7	1.4	1.0	1.2
Drinking coffee, tea and water	1.5	1.5	1.5	1.6	1.8	1.8	1.0	1.3
Other	6.7	6.1	6.7	6.4	5.3	5.3	3.4	4.5
Total	**137.1**	**131.9**	**130.7**	**123.8**	**127.5**	**120.1**	**118.9**	**119.2**

(Kantar Public, 2017)

3.5.3 Domestic drinking water use by application

Vewin has periodic surveys carried out among Dutch households into the amount and application of domestic water use. Table 3.5 shows the main results of the most recent study 'Domestic Water Use 2016'[3], by Kantar Public. The main applications for domestic drinking water are the shower (41%), toilet (29%) and washing machine (12%) (Figure 3.13). Between 1995 and 2016, domestic water use per family member fell by more than 13%. This can mainly be attributed to the ever-increasing introduction of energy-efficient toilets and washing machines. Water use accounted for by bathing fell sharply as well. Water use accounted for by showering, on the other hand, increased over time (Figure 3.14).

Water use accounted for by the shower increased steadily until 2007, due to both increasing shower frequency and shower duration. Shower frequency has fallen since 2007 (from 0.80 times per person per day to 0.72 in 2013 and 0.69 in 2016), yet water use accounted for by showering nevertheless continued to rise until 2013 as a result of longer shower times and the emergence of the comfort shower. The average shower time increased from 7.9 minutes in 2007 to 8.9 minutes in 2013. According to the survey, this fell again to 7.6 minutes between 2013 and 2016[4]. The last study also measured a higher penetration of the water-saving shower head (from 45% to 49%) and a decrease in the penetration of the comfort shower (from 4% to 3%).

3 *From the 2016 Domestic Water Use report, the corrected results are included in the 2022 Dutch Drinking Water Statistics in Table 3.5 and subsequent tables and figures. This is because, contrary to Vewin's water supply statistics, the measurement based on the sample by Kantar Public indicated a significant fall in drinking water use per capita. Since this fall is most likely due to a major random sampling error, the sample results of the Domestic Water Use survey were corrected. In the Domestic Water Use report, the corrected results are shown next to the sample-based results measured originally. Appendix 6 of the 2016 Domestic Water Use report explains how the corrected results have been calculated.*

4 *This sharp decrease is probably due in part to a major random sampling error in the 2016 Domestic Water Use survey.*

Figure 3.13

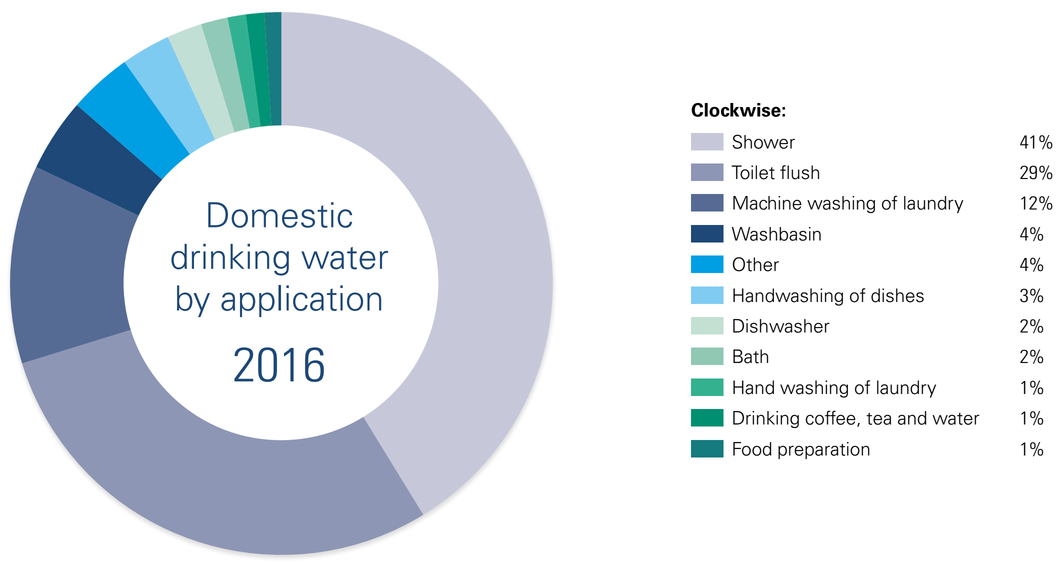


Figure 3.14 Development in drinking water use by application

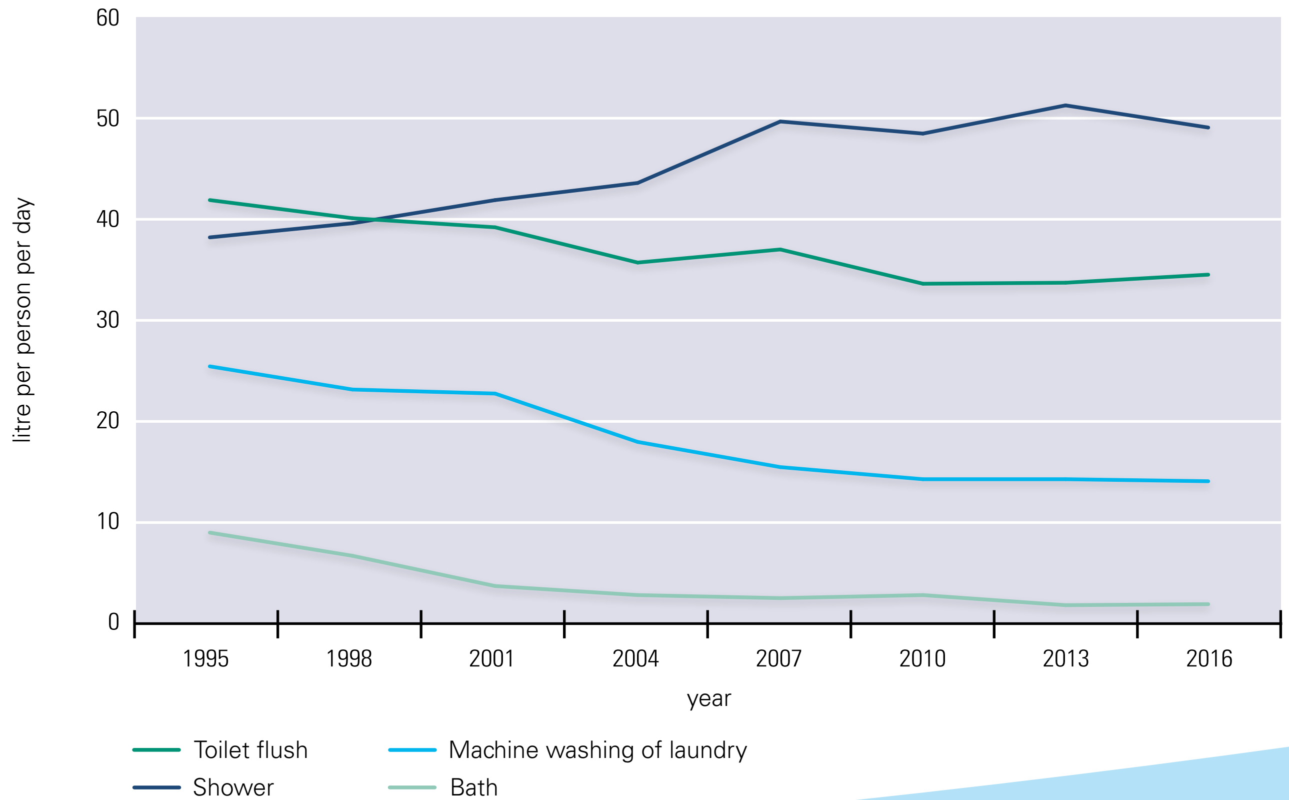


Table 3.6 Water use by age 2016 (litre per person per day)

	0-12 yrs.	13-17 yrs.	18-24 yrs.	25-34 yrs.	35-44 yrs.	45-54 yrs.	55-64 yrs.	65+ yrs.
Bath	1.4	1.3	0.0	3.1	4.8	2.5	1.1	1.2
Shower	47.1	51.7	64.2	60.7	54.4	58.4	42.6	32.7
Washbasin	5.8	4.6	3.6	4.1	4.5	5.4	5.6	6.2
Toilet flush	24.9	26.1	29.0	33.0	31.8	37.5	37.1	44.9
Hand washing of laundry	0.6	0.5	0.4	0.8	0.6	1.4	2.1	2.7
Machine washing of laundry	11.2	10.1	12.4	14.0	12.7	15.5	17.3	16.6
Handwashing of dishes	1.7	1.1	1.8	2.9	1.8	3.3	5.4	7.5
Dishwasher	2.8	2.5	2.6	1.9	2.5	2.4	2.7	2.3
Food preparation	1.4	1.2	1.5	1.0	0.9	1.7	1.0	1.2
Coffee / tea	1.2	1.5	1.2	0.9	0.6	1.0	0.5	0.8
Drinking water	1.6	0.8	0.5	0.7	0.4	0.5	0.2	0.3
Other	12.7	3.6	9.0	5.0	3.6	4.5	2.8	4.7
Total	112.4	105.0	126.1	128.1	118.7	134.3	118.3	121.3

(Kantar Public, 2017)

Table 3.7 Water use by size of household 2016 (litre per person per day)

	1-pers.	2-pers.	3-pers.	4-pers.	5+
Bath	0.4	1.5	2.2	3.5	3.5
Shower	45.2	47.6	57.1	50.6	45.1
Washbasin	5.4	5.3	5.2	4.8	5.2
Toilet flush	39.2	40.1	32.9	28.9	26.9
Hand washing of laundry	2.7	1.8	0.5	0.6	0.4
Machine washing of laundry	16.6	17.4	11.9	12.2	9.9
Handwashing of dishes	8.0	4.5	1.8	1.6	1.2
Dishwasher	0.8	3.4	2.4	3.0	2.2
Food preparation	1.5	1.1	1.7	0.9	0.8
Coffee / tea	1.1	0.6	0.8	0.8	1.0
Drinking water	0.4	0.4	0.6	0.4	1.1
Other	4.9	4.1	6.6	4.6	3.4
Total	126.3	127.9	123.6	111.7	100.7

(Kantar Public, 2017)

In Tables 3.6 – 3.8, water use is broken down by age, household size and gender. Young people generally use more water for showering. The elderly, on the other hand, use more water for flushing the toilet.

People from small households use more water per person than people from larger households. This is because certain applications can be used simultaneously for more family members, for example, the shared use of a washing machine. With that, in the case of small households, the elderly (with a relatively high use of the toilet) are somewhat overrepresented in these categories.

Another striking aspect is that women use more water than men. This is mainly due to a higher water consumption as a result of a higher frequency of toilet use.

Table 3.8 Water use by gender 2016 (litre per person per day)

	Male	Female
Bath	1.9	2.1
Shower	49.9	48.7
Washbasin	5.5	4.9
Toilet flush	31.0	37.9
Hand washing of laundry	1.0	1.5
Machine washing of laundry	13.4	14.7
Handwashing of dishes	3.1	3.8
Dishwasher	2.7	2.3
Food preparation	0.9	1.4
Coffee / tea	0.8	0.8
Drinking water	0.5	0.5
Other	3.9	5.0
Total	114.5	123.6

(Kantar Public, 2017)

3.5.4 Business drinking water use by economic activity

Statistics Netherlands periodically reports a breakdown of drinking water use in the Netherlands (Statistics Netherlands, 2021). Statistics Netherlands derives the distribution of total drinking water use between households and the business market from Vewin's drinking water statistics. Statistics Netherlands further subdivides business use into economic activity. The most recent data for which this was done was business use for 2019. An overview of the subdivision is shown in Table 3.9. The code in the first column is the so-called SIC code according to Statistics Netherlands' latest standard industrial classification for economic activities (SIC 2008).

Table 3.9 Business drinking water use by economic activity (million m³)

	2005	2010	2015	2018	2019
A Agriculture, forestry and fishing	47.6	43.8	42.7	48.9	43.8
B Mineral extraction	3.8	3.6	2.5	2.9	2.2
C Industry	142.8	138.0	128.3	132.0	144.6
of which:					
10-12 Food, drink and tobacco industry	59.7	59.7	53.4	56.4	58.7
13-15 Textiles, clothing and leather industry	2.5	2.5	1.4	1.4	1.4
16-18 Wood, paper and printing industry	5.0	3.0	6.0	5.3	6.8
19 Oil industry	16.2	13.4	8.7	7.8	10.0
20 Chemical industry	22.7	25.1	33.6	33.9	41.0
21 Pharmaceutical industry	15.5	8.4	5.8	4.8	6.4
22-23 Plastics and building materials industry	7.4	8.9	6.2	7.2	6.2
24-25 Base metals, metal manufacturing industry	4.4	4.6	3.5	4.9	5.2
26-27 Electrical and electronics industry	3.9	5.0	3.9	3.7	3.0
28 Machinery industry	2.5	3.8	2.8	3.6	3.0
29-30 Transport industry	2.2	2.3	2.4	2.2	2.5
31-33 Other industries and repairs	0.9	1.1	0.7	0.9	0.7
D Energy production and supply	2.3	8.3	3.5	3.5	4.3
E Water companies and waste management	4.6	6.1	3.3	5.1	6.2
F Construction industry	3.0	2.9	2.6	2.8	2.6
Industry total (B-F)	*157*	*159*	*140*	*146*	*160*
G-I Trade, transport and hospitality	33.7	35.5	37.6	38.5	40.0
J Information and communications	0.8	0.8	0.9	1.0	0.9
K Financial services	2.1	2.0	1.9	1.9	1.5
L Rental and sales of real estate	3.9	4.0	3.9	4.1	3.5
M-N Business services	3.8	4.0	4.3	4.5	4.4
O-Q Government and healthcare	26.6	29.5	30.0	30.3	28.6
R-U Culture, leisure, other services	20.5	25.0	25.5	27.5	26.5
Other business total (G-U)	*91*	*101*	*104*	*108*	*105*
Total (A-U)	296	304	287	303	309

(Statistics Netherlands, 2021)

3.6 Weather influence and seasonal pattern

3.6.1 Weather influence

In § 3.5.2, it emerged that water use in the period 2018 – 2020 rose sharply due to the heat and drought. In 2018, the sector was confronted with a stronger than expected increase in water demand. In that context, the sector forecast from 2017 was evaluated in 2019 and compared with the sum of the individual company forecasts (Figure 3.7). To gain an impression of the extent to which the increase in use from 2015 to 2018 was influenced by meteorological conditions, an analysis of a long-term time series of drinking water use (2005 – 2019) was performed. The analysis was performed on the basis of the daily supply of drinking water to the distribution network of six drinking water companies: Brabant Water, Dunea (Hague region and Vliet region), Oasen, PWN, Waternet and WML, together account for about half of the Dutch drinking water use.

Based on this data, Icastat, at the request of Vewin, standardised water use in the years 2015 – 2018 according to water use under normal meteorological conditions, making it possible to estimate that half of the increase in water use in the period 2015 – 2018 (+8%) had a meteorological background (+4%) and the other half a non-meteorological background.

3.6.2 Seasonal pattern

The seasonal pattern of water use has been mapped out on the basis of this data as well. Table 3.10 shows the months of the year and how the 15-year average of the daily supply relates to the annual average of daily supply. The figures for 2018 are presented separately by way of comparison. In figure 3.15 the information is also shown in graph form.

The long-term figures show an above-average water use for the months of April to July and a below-average use for the other months. Drinking water use is highest in June, with an average of 6.4% more drinking water used per day than on an average day throughout the year. In December, daily drinking water use is lowest at an average of 3.7% below the annual average.

Table 3.10 Index average daily supply

Month	2005 - 2019	2018
1	96.8	94.0
2	97.4	94.9
3	99.0	97.7
4	102.5	99.3
5	103.3	103.7
6	106.4	108.4
7	104.0	118.2
8	97.8	100.6
9	99.8	97.3
10	98.4	97.2
11	98.3	94.8
12	96.3	93.2
Total	100	100

Figure 3.15 shows that in the very hot and dry year of 2018, the differences between the average daily use per month was much larger compared to the multi-year averages. In addition, the peak of the average daily use in that year was not in June, but in July. Average daily use in July was more than 18% above the annual average of 2018.

Considered on a daily basis, use in the years 2005 – 2019 varies between +39% and -15% of the average daily use. Daily use was highest on 1 July 2015 (+39%) and lowest on 31 July 2005 (-15%).

3.7 Financial aspects

3.7.1 Drinking water taxes

Drinking water companies are subject to provincial groundwater levies, pipeline and concession fees (municipal levy on encroachments in public land), tap water tax and value added tax (VAT) (9%). The first two are cost-increasing taxes that are covered via the drinking water rate, whereas the latter two taxes (tap water tax and VAT) are consumption taxes that the water company pays to the tax authorities on behalf of the consumer. These are in addition to the drinking water rate of the water company and are not part of the drinking water turnover. Until 2012, the companies were also subject to groundwater tax.

Figure 3.15 Index average daily supply in the months of the year

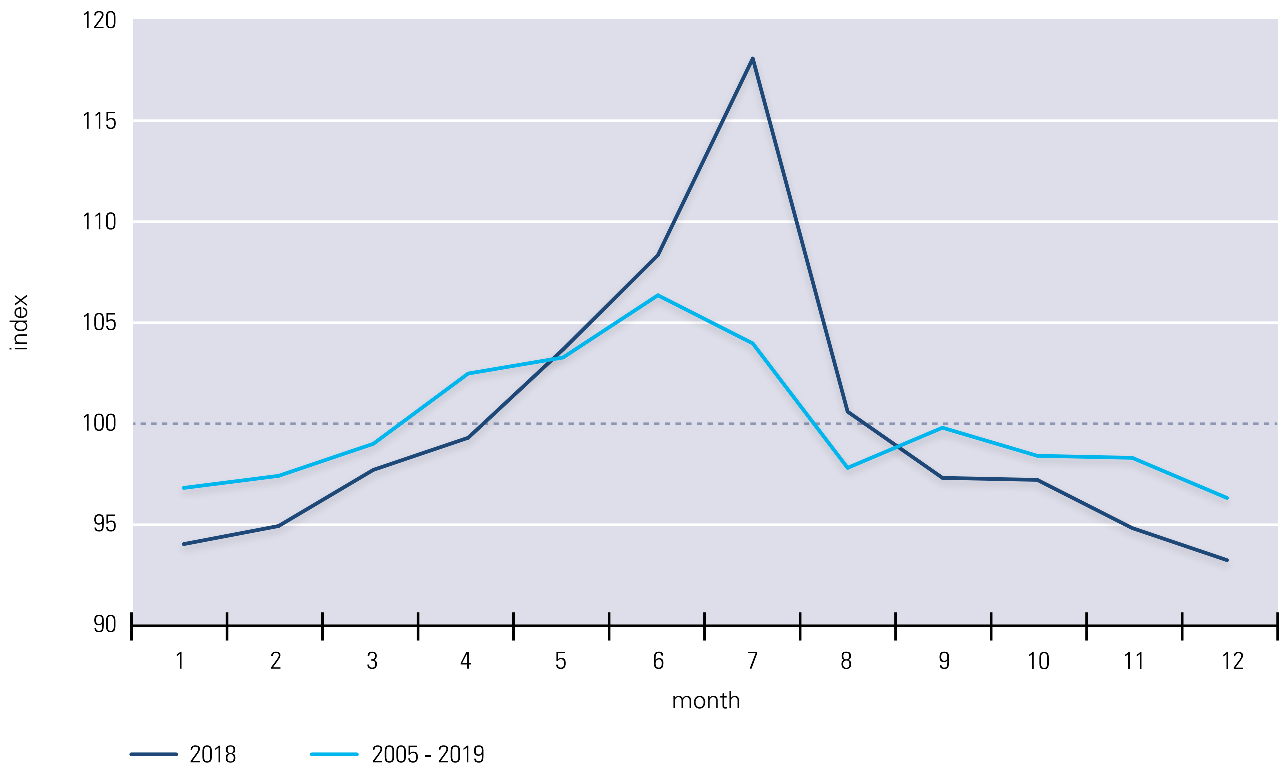


Table 3.11 Water taxes pursuant to the Environmental Taxes Act, 1990 – 2020 (cents/m³)

	1990	1995	2000	2010	2011	2012	2013	2014	2019	2020	2021
Groundwater tax											
standard rate	-	15.4	16.0	19.51	19.63	-	-	-	-	-	-
infiltration discount	-	12.7	13.4	16.34	16.44	-	-	-	-	-	-
Tap water tax	*-*	*-*	*12.9*	*15.7*	*15.8*	*16.1*	*16.5*	*33.0*	*34.3*	*34.8*	*35.4*

Table 3.12 Provincial groundwater levies 2005-2020 (cents/m³)

	2005	2010	2015	2019	2020
Groningen	2.00	1.11	1.68	1.68	1.68
Friesland	1.13	1.13	1.13	1.32	1.32
Drenthe	1.00	1.06	1.15	1.12	1.12
Overijssel	1.36	1.36	1.36	1.60	1.60
Flevoland	1.71	1.14	1.41	1.41	1.41
Gelderland	1.30	1.30	1.30	1.30	1.30
Utrecht	1.50	1.53	1.53	1.53	1.53
Noord-Holland	0.81	0.85	0.85	0.85	0.85
Zuid-Holland	1.13	1.13	1.13	0.50	0.50
Zeeland	2.54	2.75	3.17	3.17	3.17
Noord-Brabant	1.90	1.90	1.90	1.90	1.90
Limburg	1.13	1.39	1.52	1.63	1.66
Average	1.46	1.39	1.51	1.50	1.50

Table 3.11 shows the rate development of the tap water tax and the national groundwater tax. Tap water tax is based on the Environmental Taxes Act and so was national groundwater tax before it was abolished. The groundwater tax on groundwater abstractions was introduced in 1995 and abolished in 2012. Since 2000, the tap water tax has been levied on the first 300 m³ of tap water drawn. This tax gradually increased from 12.9 to 16.5 cents per m³ between 2000 and 2013 and doubled to 33.0 cents per m³ in 2014. In 2021, the tax will be 35.4 cents per m³.

The rate for the provincial groundwater levy varies per province. Averaged over the provinces, the rate is 1.5 cents per m³ of abstracted groundwater (Table 3.12).

A number of municipalities levy pipeline and concession fees (municipal levy on encroachments in public land). The rate varies per municipality (Table 3.15). In 2017, it was decided by law that the municipal levy on encroachments in public land pertaining to drinking water pipes would be abolished with effect from 1 January 2022. Until then, a transition period applies during which municipalities can phase out the rates and fees.

If the tax burden is determined by dividing the amounts paid in the sector by drinking water sales to the customer, then in 2020, it will be 1.1 cents/m³ for provincial groundwater levies and 2.8 cents/m³ for pipeline and concession fees.

Figure 3.16 shows the development of drinking water taxes. The taxes on drinking water in 2020 amount to a total of EUR 516 million (€0.45/m³). Due to the doubling of the tap water tax rate in 2014, total drinking water taxes returned to approximately the same level as in 2011, the final year before the abolition of the groundwater tax. In 2019, the tax burden on drinking water was increased again by raising the VAT rate on drinking water from 6% to 9%.

Of the drinking water taxes in 2020, a total of EUR 45 million (€0.04/m³) consists of cost-increasing taxes (provincial groundwater levy and pipeline and concession fees) and EUR 471 million (€0.41/m³) of the tap water and VAT consumption taxes. On average, water taxes now account for 27.6% of the average consumer price for drinking water in the Netherlands (Table 3.13). The tax burden for households has risen to 29.5% of the consumer price (Table 3.14, Figure 3.17).

Figure 3.16 Development of drinking water taxes

Table 3.13 Average consumer price in the Netherlands [1]

	2019	2020	Percentage of total price
	€ / m³	*€ / m³*	%
Costs water company	1.15	1.17	72.4%
Cost price increasing taxes	0.04	0.04	2.4%
Average rate	*1.19*	*1.20*	
Tap water tax and VAT	0.40	0.41	25.2%
Total consumer price	1.59	1.61	

1) Households and business market together.

Table 3.14 Consumer price for households

	2019	2020	Percentage of total price
	€ / m³	*€ / m³*	%
Costs water company	1.26	1.29	70.5%
Cost price increasing taxes	0.04	0.04	2.1%
Average rate	*1.30*	*1.32*	
Tap water tax and VAT [1]	0.49	0.50	27.3%
Total consumer price	1.79	1.82	

1) 2019: € 0.343 + 9% VAT on (€ 1.299 + € 0.343); 2020: € 0.348 + 9% VAT on (€ 1.324 + € 0.348).

3.7.2 Consumer price (based on turnover/sales ratio; including tap water tax and VAT)

Tables 3.13 and 3.14 show the structure of the consumer price, including the consumption taxes (tap water tax and VAT) that the customer pays on top of the drinking water rate.

The average consumer price in 2020 is €1.61 compared to €1.59 in 2019 (+1.6%). The consumer price for the user group households is an average of €1.82 compared to €1.79 in 2019 (+1.9%). The drinking water bill for an average household in 2020 (use 104.9 m³/year) amounts to €191, compared to €182 in 2019 (based on 101.6 m³/year). The annual bill excluding consumption taxes for the average household rose from €132 to €139.

Figures 3.17 and 3.18 show the percentage development of drinking water taxes and the effect of the taxes on the consumer price for households. Over the last decade, the price has increased from €1.68/m³ in 2010 to €1.82/m³ in 2020 (+8.5%). Excluding taxes, the price increased from €1.27/m³ to €1.29/m³ (+1.6%). During this period, the percentage of taxes increased from 24.6% to 29.5%.

The development of the consumer price, including taxes, shows various breaks in the trend. The increase in 1995 was due to the introduction of the national groundwater tax. In 1999, the VAT was raised from 6% to the then general rate of 17.5%. The VAT increase was reversed in 2000, but this was offset against the introduction of the tap water tax. The fall in 2012 can be attributed to the abolition of the national groundwater tax in that year, whereas the rise in 2014 is due to the doubling of the tax water tax rate. Finally, the increase in 2019 is due to the increase in VAT from 6% to 9%.

Figure 3.17 Share of taxes in the consumer price for households

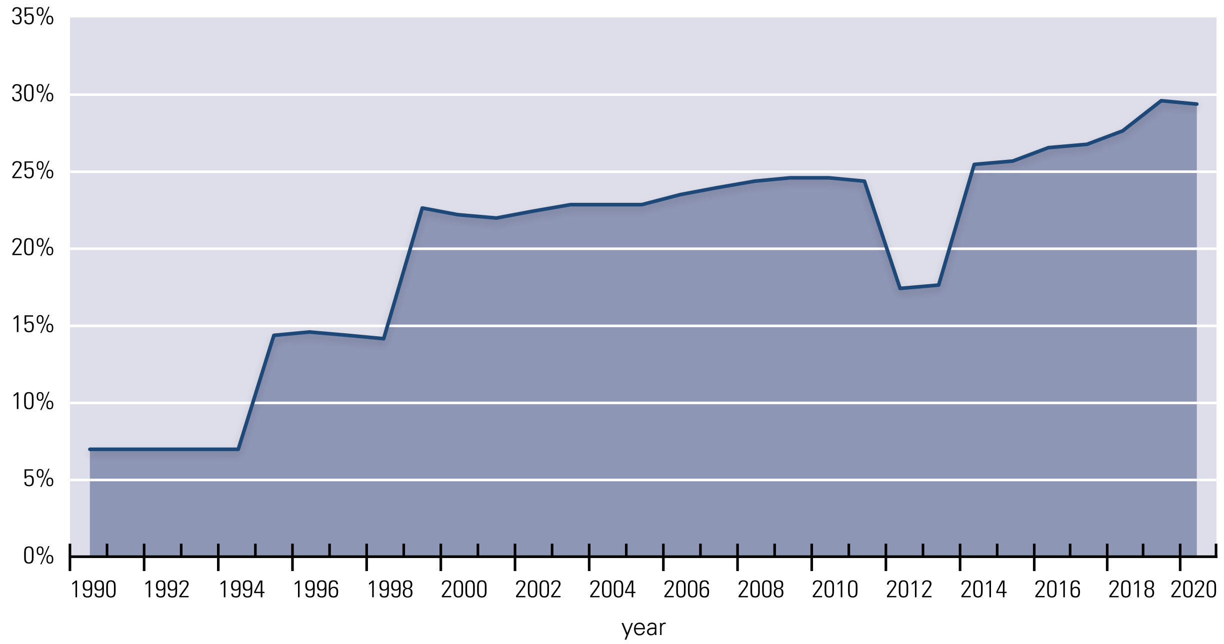
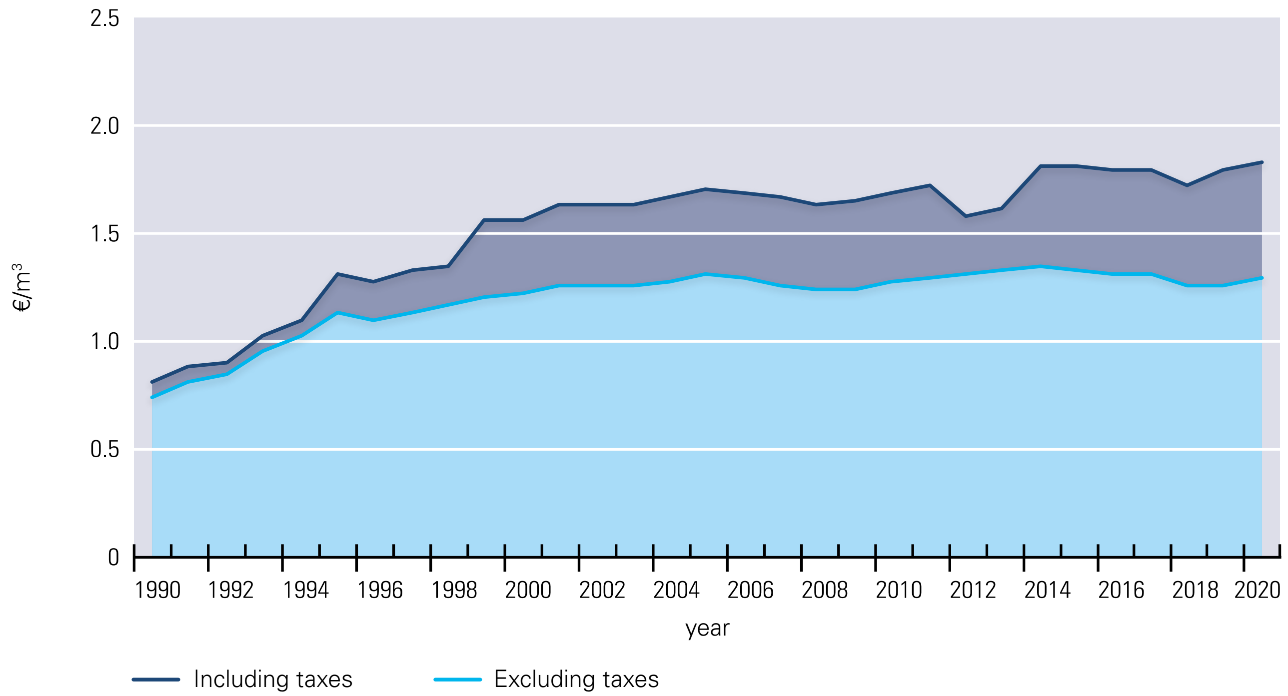


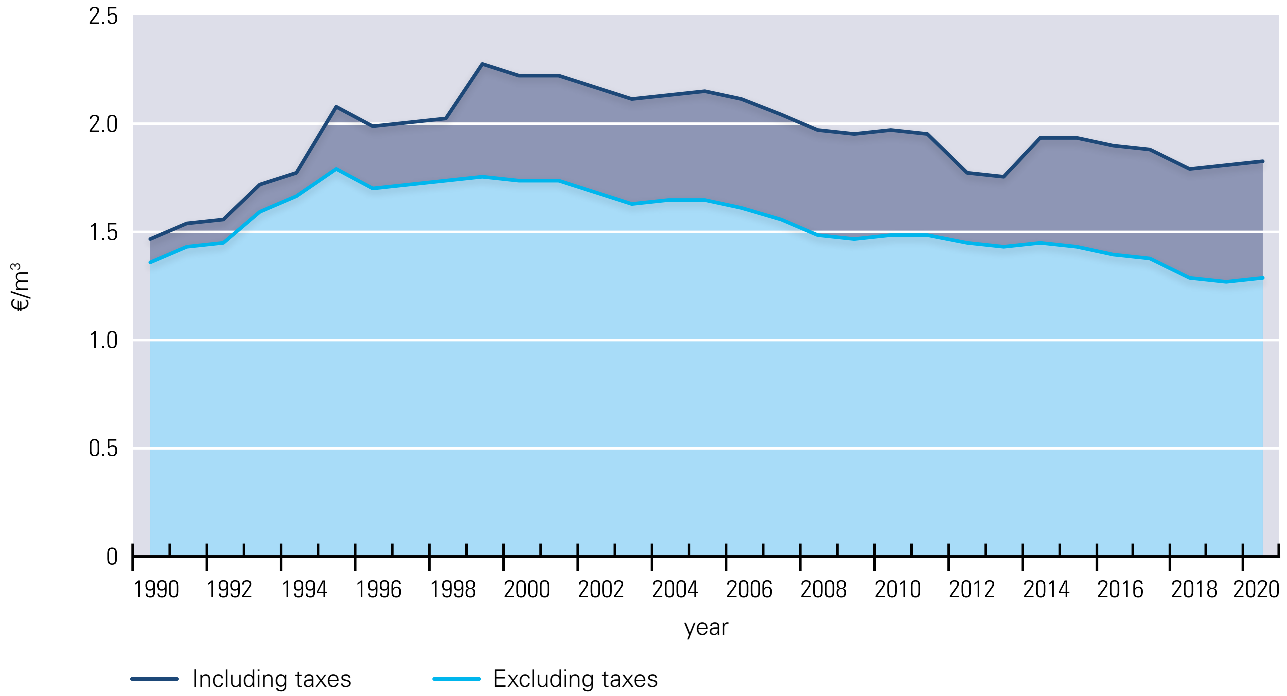
Figure 3.18 Development of the nominal consumer price for households [1)]



1) The nominal consumer price is the actual price charged.

What remains after correction for inflation is a real price reduction of €0.15 per m^3 compared to ten years ago: €1.82 per m^3 in 2020 compared to €1.97 per m^3 in 2010 (Figure 3.19).

Figure 3.19 Development of the real consumer price for households (2020 = 100) [1)]



1) The real price is the price adjusted for general price increase (inflation), to the price level of 2020.

3.7.3 Drinking water rates for households by region (based on rate regulations, excluding tap water tax and VAT)

The drinking water companies draw up a rate scheme prior to the start of each calendar year. The rates for households are listed in Table 3.15. All companies charge a rate per m³ (variable rate) and a fixed amount per year (standing charge). In addition, in a number of municipalities, an amount is charged that drinking water companies pay to the municipalities as compensation for having pipes in the municipal subsoil (pipeline and concession fee).

The result in the column *Total* is calculated based on the variable rate, the standing charge and the municipal pipeline and concession fee (insofar as levied) and represents the drinking water rate per m³ in an area for a family using 100 m³ per year, exclusive of the consumption taxes tap water tax and VAT (Vewin, 2021). In 2021, this rate will be an average of €1.38 per m³ of drinking water, compared to €1.35/m³ in 2020. On average, 54% of this is a volumetric rate (€0.75/m³) and 46% a fixed amount (standing charge and municipal pipeline and concession fee: €63.23/year, which converted is €0.63/m³).

Table 3.15 Household drinking water rates by subarea 2020 - 2021 [1)]

	2020	2021				Change
	Total [2)]	Standing charge [3)]	Pipeline and concession fee	Volumetric rate	Total [2)]	Total 2021 compared to 2020
	€ per m³	*€ per annum*	*€ per annum*	*€ per m³*	*€ per m³*	*%*
Waterbedrijf Groningen						
General (municipalities without concession fees)	1.14	52.15	-	0.667	1.19	4.2%
Delfzijl	1.24	52.15	4.36	0.667	1.23	-0.6%
Oldambt	1.38	52.15	24.04	0.667	1.43	3.3%
WMD Drinkwater	1.27	69.98	-	0.63	1.33	5.0%
Vitens						
General (municipalities without concession fees)	1.04	42.00	-	0.64	1.06	1.9%
Dronten	1.19	42.00	14.29	0.64	1.20	0.9%
Lelystad	1.16	42.00	11.64	0.64	1.18	1.3%
Wageningen	1.56	42.00	24.79	0.64	1.31	-16.0%
Wijk bij Duurstede	1.29	42.00	23.43	0.64	1.29	0.7%
Zeewolde	1.27	42.00	21.55	0.64	1.28	0.3%
PWN						
General (municipalities without concession fees)	1.74	53.93	-	1.22	1.76	1.4%
Beverwijk	2.07	53.93	29.22	1.22	2.05	-1.0%
Waternet	1.54	76.42	-	0.83	1.59	3.3%

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	2020	2021				Change
	Total [2)]	Standing charge [3)]	Pipeline and concession fee	Volumetric rate	Total [2)]	Total 2021 compared to 2020
	€ per m³	*€ per annum*	*€ per annum*	*€ per m³*	*€ per m³*	*%*
Dunea						
General (municipalities without concession fees)	1.57	60.36	-	1.00	1.60	1.8%
Alphen aan den Rijn (centre Benthuizen)	1.86	60.36	29.20	1.00	1.90	2.2%
Den Haag	1.75	60.36	17.80	1.00	1.78	1.8%
Katwijk	1.86	60.36	29.80	1.00	1.90	2.1%
Lansingerland	1.67	60.36	8.90	1.00	1.69	1.6%
Leiden	1.88	60.36	29.80	1.00	1.90	1.3%
Leidschendam-Voorburg	1.63	60.36	5.70	1.00	1.66	1.8%
Lisse	2.09	60.36	55.40	1.00	2.16	3.1%
Noordwijk	2.14	60.36	58.90	1.00	2.19	2.4%
Oegstgeest	1.96	60.36	39.50	1.00	2.00	2.0%
Rotterdam (Nesselande)	1.59	60.36	1.30	1.00	1.62	1.5%
Rijswijk	1.68	60.36	11.10	1.00	1.71	2.0%
Teylingen	2.08	60.36	50.00	1.00	2.10	1.3%
Voorschoten	1.79	60.36	22.20	1.00	1.83	1.8%
Wassenaar	2.00	60.36	42.00	1.00	2.02	1.3%
Zoetermeer	1.63	60.36	5.70	1.00	1.66	1.8%
Zuidplas (Zevenhuizen-Moerkapelle-Nieuwerkerk a/d IJssel)	1.85	60.36	28.90	1.00	1.89	2.5%
Oasen						
General (municipalities without concession fees)	1.46	75.00	-	0.726	1.48	1.1%
Alblasserdam	1.62	75.00	16.25	0.726	1.64	0.9%
Alphen aan den Rijn	1.68	75.00	22.28	0.726	1.70	1.2%
Bodegraven-Reeuwijk	1.62	75.00	16.08	0.726	1.64	0.9%
Gorinchem	1.51	75.00	5.32	0.726	1.53	1.0%
Gouda	1.62	75.00	15.36	0.726	1.63	0.9%
Hardinxveld-Giessendam	1.48	75.00	2.42	0.726	1.50	1.0%
Hendrik Ido Ambacht	1.58	75.00	11.26	0.726	1.59	0.8%
Kaag en Braassem	2.15	75.00	72.80	0.726	2.20	2.3%
Leiderdorp	1.60	75.00	14.52	0.726	1.62	1.0%
Molenlanden	1.69	75.00	22.30	0.726	1.70	0.5%
Nieuwkoop	1.58	75.00	11.39	0.726	1.59	0.8%
Papendrecht	1.62	75.00	16.21	0.726	1.64	1.0%
Sliedrecht	1.61	75.00	14.70	0.726	1.62	0.8%

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	2020	2021				Change
	Total 2)	Standing charge 3)	Pipeline and concession fee	Volumetric rate	Total 2)	Total 2021 compared to 2020
	€ per m³	*€ per annum*	*€ per annum*	*€ per m³*	*€ per m³*	*%*
Vijfheerenlanden (Leerdam)	1.57	75.00	10.89	0.726	1.58	1.2%
Vijfheerenlanden (Zederik)	1.68	75.00	22.93	0.726	1.71	1.3%
Waddinxveen	1.57	75.00	10.77	0.726	1.58	0.9%
Zoeterwoude	2.01	75.00	52.45	0.726	2.00	-0.3%
Zuidplas (Moordrecht)	1.66	75.00	21.85	0.726	1.69	2.0%
Zwijndrecht	1.63	75.00	16.46	0.726	1.64	0.6%
Evides Waterbedrijf						
General (municipalities without concession fees)	1.55	70.72	-	0.859	1.57	1.0%
Rotterdam	1.63	70.72	7.91	0.859	1.65	1.0%
Vlaardingen	1.65	70.72	10.36	0.859	1.67	0.9%
Maassluis	1.70	70.72	14.24	0.859	1.71	0.8%
Schiedam	1.65	70.72	10.46	0.859	1.67	1.1%
Den Haag (Wateringse Veld)	1.58	70.72	3.73	0.859	1.60	1.2%
Dordrecht	1.83	70.72	28.13	0.859	1.85	0.7%
Zwijndrecht (Heerjansdam)	1.72	70.72	16.41	0.859	1.73	0.8%
Nissewaard	1.81	70.72	25.30	0.859	1.82	0.7%
Hoeksche Waard	1.78	70.72	22.51	0.859	1.79	0.7%
Delft	1.56	70.72	0.96	0.859	1.58	1.1%
Hulst	1.70	70.72	15.63	0.859	1.72	1.1%
Borsele	1.70	70.72	15.39	0.859	1.72	1.0%
Kapelle	1.71	70.72	16.18	0.859	1.73	0.8%
Middelburg	1.66	70.72	10.38	0.859	1.67	0.9%
Noord-Beveland	1.68	70.72	12.83	0.859	1.69	0.8%
Reimerswaal	1.72	70.72	16.90	0.859	1.74	0.9%
Schouwen-Duiveland	1.71	70.72	16.18	0.859	1.73	0.9%
Tholen	1.69	70.72	14.12	0.859	1.71	0.9%
Veere	1.73	70.72	16.99	0.859	1.74	0.5%
Vlissingen	1.67	70.72	11.88	0.859	1.69	0.9%
Terneuzen	1.71	70.72	16.14	0.859	1.73	1.0%
Goes	1.72	70.72	16.25	0.859	1.73	0.7%
Brabant Water	1.13	69.84	-	0.46	1.16	2.1%
WML	1.48	87.25	-	0.782	1.65	11.8%
The Netherlands 4)	1.35	59.53	3.70	0.75	1.38	2.5%

1) Excluding tap water tax on the first 300 m³ and excluding VAT (9%).
2) The total rate per m³ for a family consuming 100 m³ per annum.
3) Including any meter hire and supplementary charge for public firewater.
4) The total per m³ for the Netherlands was calculated based on the average standing charge, the average pipeline and concession fee and the average volumetric rate at 100 m³ per household. If calculated based on the turnover and sales to households quotient, the outcome for 2020 is € 1.32/m³ (Table 3.14).

The rates in the regions vary between €1.06/m³ in the Vitens distribution area (municipalities without pipeline and concession fee) and €2.20/m³ in a sub-area of Oasen (Kaag en Brasem). A large part of this spread is caused by the municipal pipeline and concession fee. Without this fee, the rates would vary between the aforesaid €1.06/m³ and €1.76/m³ in the PWN distribution area.

3.7.4 Financial balance

Table 3.16 shows the financial balance of the drinking water sector. The balance sheet was established by combining the individual statements of the drinking water companies. The total balance sheet value at year-end 2020 is EUR 7.6 billion. Of this amount, 2.7 billion (36.0%) was financed through equity, 4.2 billion (55.5%) with loan capital and 0.6 billion (8.6%) with other capital (third-party contributions and provisions).

Table 3.16 Financial balance sheet drinking water companies as at 31-12-2020 (in million €)

Assets		Liabilities	
Fixed assets		*Shareholders' equity*	
- tangible fixed assets	6,740	- share capital	36
- intangible fixed assets	92	- reserves	2,689
- financial fixed assets	316		
- total	7,149	*Other capital*	
		- third party contributions	428
		- provisions	220
Current assets		*Long-term loan capital*	3,308
- stocks	15		
- account receivables/debtors	396	*Short-term loan capital*	
- liquid assets/cash	13	- loans	423
- total	423	- creditors	134
		- advances	30
		- other	304
		- total	891
Total	7,572	Total	7,572

3.7.5 Investments

Figure 3.20 shows the development in investment level. In the 1990s to 2008, investment gradually declined. This was related, among other things, to a fall in water demand, which meant that hardly any expansion investments in production capacity were needed. The use of less expensive piping materials (PVC), measures aimed at extending service lives and smart investing based on improved information (asset management) further contributed to limiting the investment costs. An upward trend is visible from 2008. In 2015 and 2016, investments in the production of drinking water (water extraction and treatment) slightly fell again, yet investments in distribution continued to rise. Since 2017, investments in both the drinking water production and the mains network have increased. Investments in production increased from EUR 123 million in 2017 to EUR 213 million in 2020 (+72%) and investments in distribution from EUR 307 million to EUR 375 million (+22%). In 2020, a total of EUR 643 million was invested, of which 58% in distribution, 33% in production and 5% in information and communication technology (Figure 3.21).

Figure 3.20 Development of investments

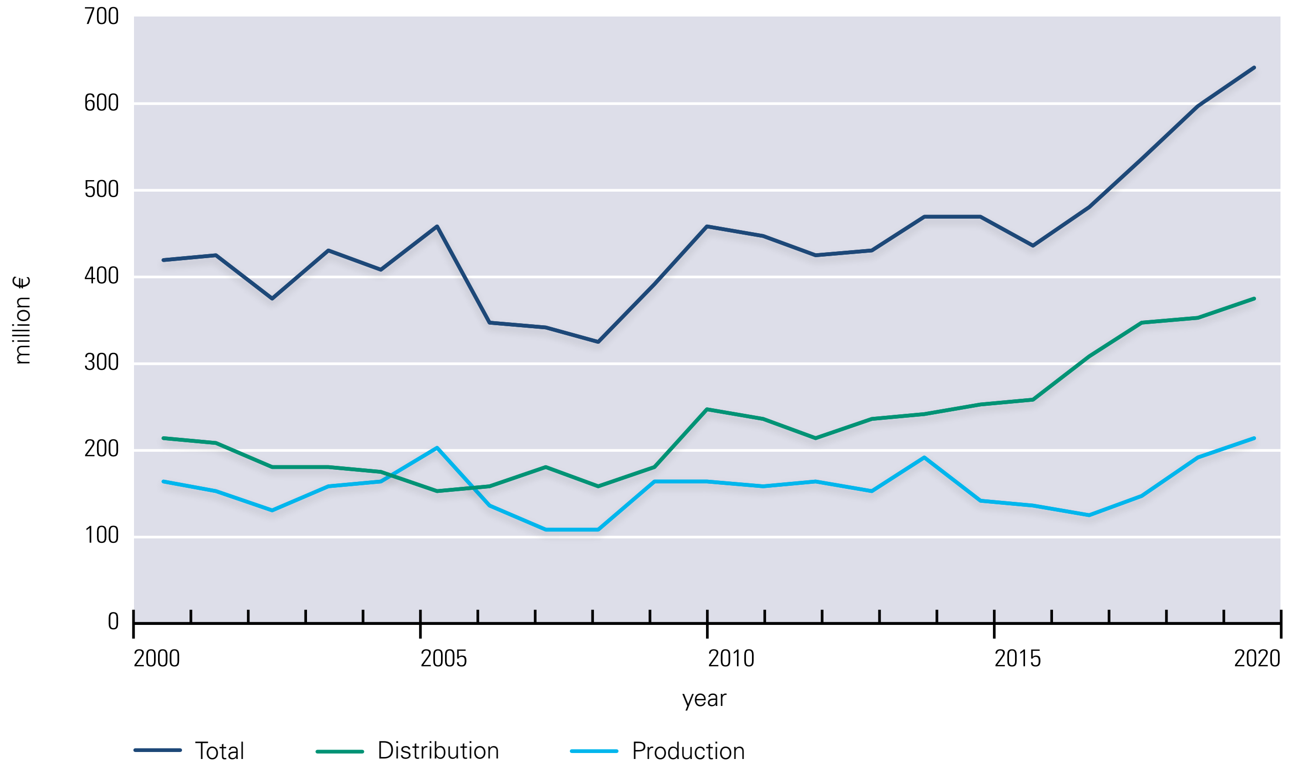
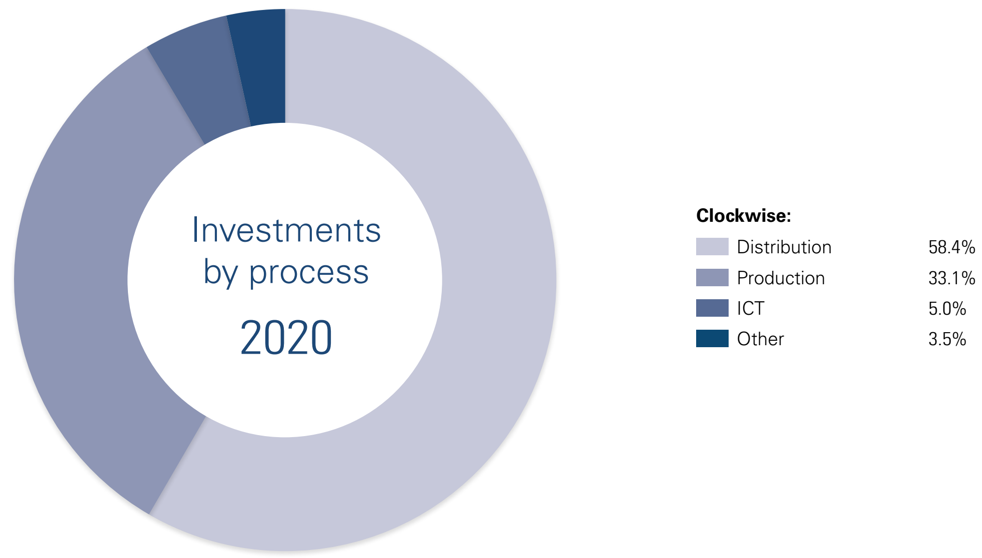


Figure 3.21



4 Drinking water quality and sustainability

The main objective of the drinking water companies is to secure a round-the-clock supply of clean and safe drinking water. In doing so, they aim to provide the best possible service to the customer and a high degree of sustainability. This chapter contains statistical data on the quality by which the sector carries out its statutory tasks (§ 4.1), on the sustainability of business operations (§ 4.2) and the contribution of the drinking water companies to the energy transition (§ 4.3).

4.1 Quality of drinking water

4.1.1 Drinking water quality

The Drinking Water Decree stipulates the maximum amount of substances and micro-organisms permitted in drinking water. To monitor the quality and check whether the drinking water meets the requirements, the drinking water companies carry out a statutory measuring programme. Quality measurements are performed both in the water from which the drinking water is prepared and in the drinking water that is produced (after the last treatment step), as well as in the distribution area.

Compliance with standards

In the context of the 2015 and 2019 Statutory Performance Comparison of Drinking Water Companies, the Human Environment and Transport Inspectorate (ILT) reported to what extent the drinking water complies with the legal standards (ILT, 2016; ILT, 2020). Sector-wide, drinking water complies with 99.95% of the measurements. In the remaining 0.05% the standard is exceeded (see Table 4.1).

Water quality index

In the context of the statutory performance comparison, ILT also reported on the water quality index (WQI). This is a measure of the water quality of drinking water that has been produced. It states the average value of parameters relative to their standard. A score of '0' is the highest achievable score and is deemed optimal drinking water. A score of '1' means that the value exactly matches the legal standard. The calculation is explained in Appendix 2.

Figure 4.1 shows the overall WQI average in the sector per parameter group. As in previous studies, the scores are very close to the value for optimal drinking water. This is because drinking water treatment is aimed at removing the difficult-to-remove substances from the water as well. Since the reliability of drinking water is paramount and because specific contaminants can often no longer be removed by basic techniques, advanced treatment techniques are needed. This removes more substances from the water than is strictly necessary by law.

Water quality score

In 2019, commissioned by Vewin, Kantar Public conducted a survey among more than 6,500 customers (650 per company) into the perception of the drinking water quality. The customers awarded the quality of the water with an average score of 8.7. This is a further improvement compared to 2015 and 2012, when customers awarded scores of 8.5 and 8.4 respectively (Figure 4.2).

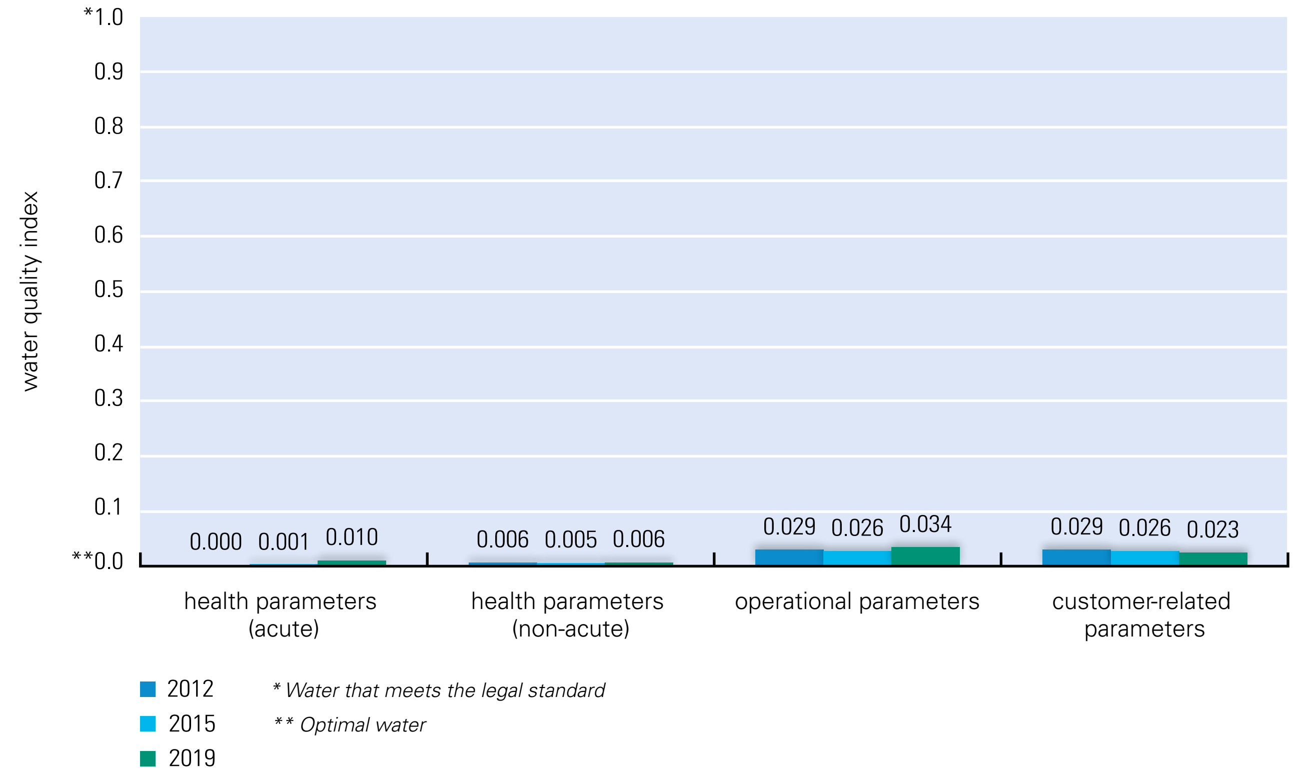
Table 4.1 Non-compliance with standards 2015 - 2019 [1)]

Parameter group	2015	2019
Health parameters (acute)	0.02%	0.05%
Health parameters (non-acute)	0.01%	0.01%
Operational parameters	0.07%	0.07%
Customer-related parameters	0.07%	0.05%
Total	0.04%	0.05%

1) Appendix 2 explains which parameters belong to each parameter group.

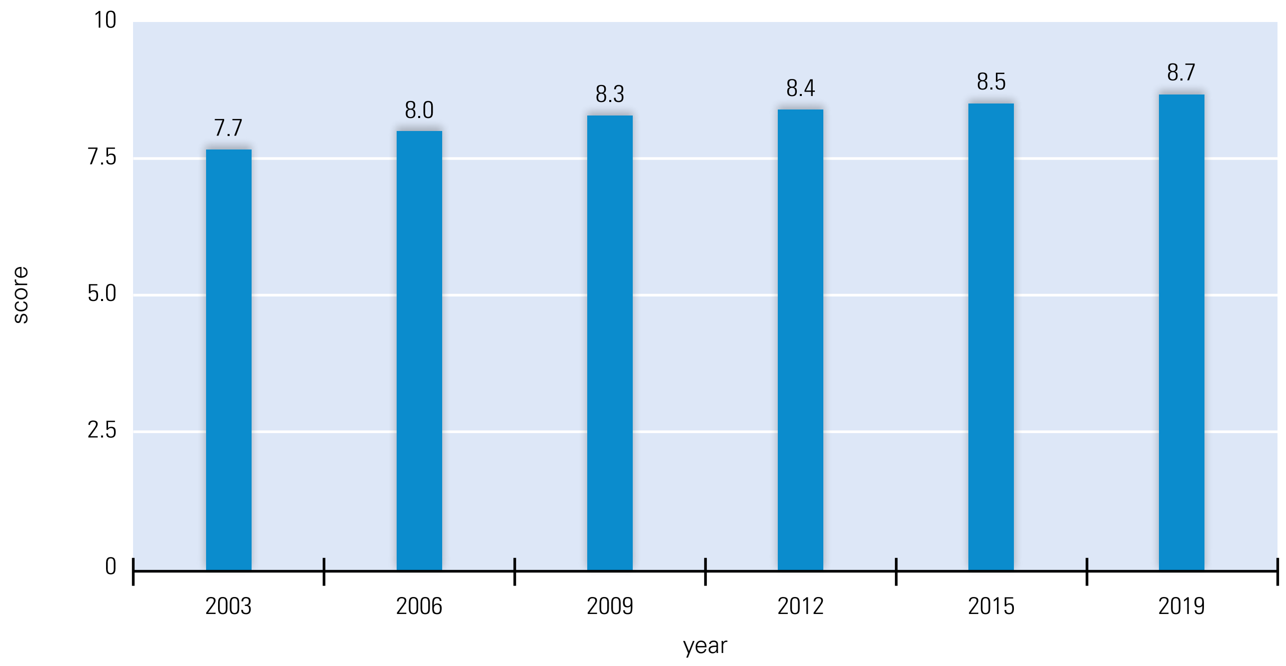
(ILT, 2020)

Figure 4.1 Water Quality Index by parameter group



(ILT, 2020)

Figure 4.2 Drinking water quality score



4.1.2 Quality of services

Customers can come into contact with the services of the drinking water company in various ways. To compare the services of drinking water companies, Kantar Public, in the context of the 2019 Performance Comparison of Drinking Water Companies, measured customer satisfaction with regard to the following services: clearing faults, maintenance, moving house/customer changes, meter reading and invoicing. This was measured in the form of scores. As regards the first three services, a total of 200 respondents per water company were surveyed who had recently been in contact with the company for the service in question. More than 600 respondents from each water company took part in the survey for meter reading and invoicing. The average sector scores per service vary between 7.5 for clearing faults and 8.3 for meter reading (Table 4.2). The average score over the five services is 7.9.

Table 4.2 Customer satisfaction by service in 2019

Service	Average score
Clearing faults	7.5
Maintenance	7.6
Moving house/customer changes	8.1
Meter reading	8.3
Invoicing	7.9
Average score for the five services	7.9

(ILT, 2020)

In addition to the measurement per service, Kantar Public, on behalf of Vewin, asked more than 6,500 customers (650 per company) to award a score for general customer satisfaction (apart from the statutory performance comparison). The drinking water companies were given an average score of 8.1 for general satisfaction. This is 0.2 higher than the score of 7.9 awarded in 2015 (Figure 4.3). The scores for general satisfaction have been compared with those for a number of other society-wide organisations that fulfil basic needs. The reference sectors are the municipality in which the respondent lives, the tax authorities, the health insurer, the respondent's internet provider and the energy company that supplies the respondent. In comparison with the other sectors, which were included in the same random check by Kantar Public, satisfaction with the services provided by the drinking water companies is relatively high:

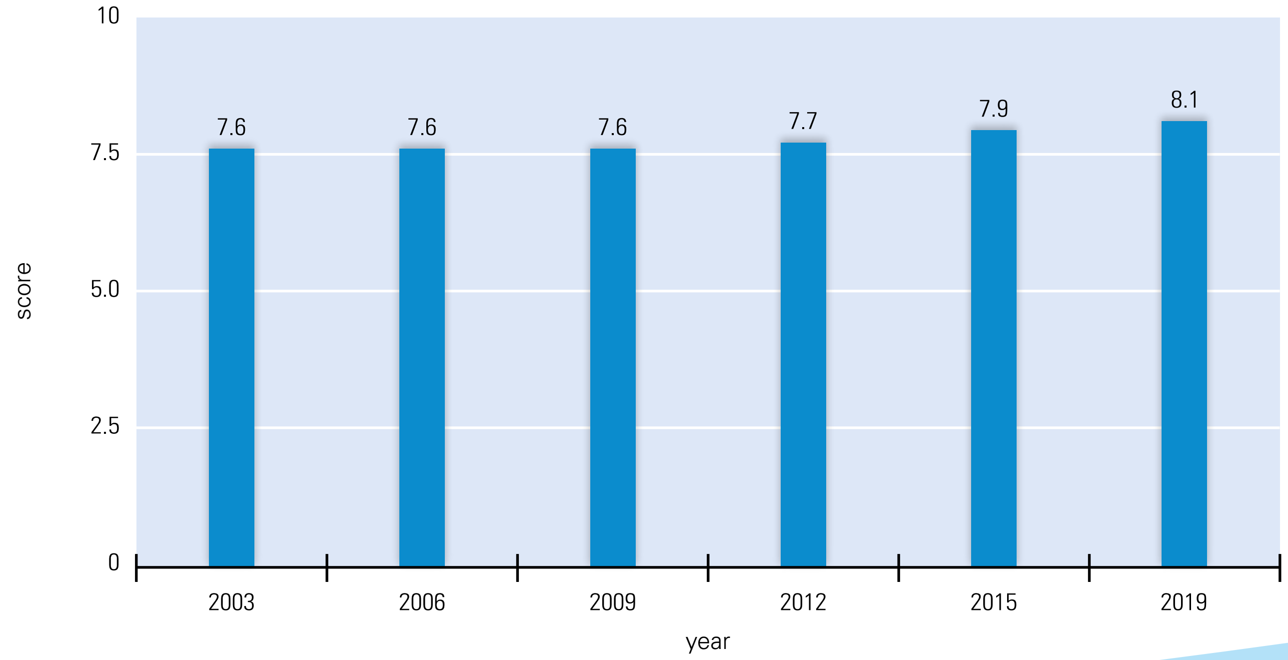
- Drinking water company: 8.1
- Municipality: 6.9
- Tax authorities: 6.5
- Health insurer: 7.5
- Internet provider: 7.4
- Energy company: 7.7

4.1.3 Water pressure and continuity

Water companies must supply the customer with drinking water of sufficient pressure. This must be at least 150 kilopascal (kPa) upon delivery. In order to realise this in every customer situation throughout the network, the companies apply an on average slightly higher pressure. As a result, customers at the end of the mains network can be supplied with water of sufficient pressure as well. The average water pressure upon delivery to the customer varies per drinking water company, but ranges between 258 kPa and 496 kPa, while the average pressure in the sector is 324 kPa (ILT, 2020).

In addition to the average water pressure, the 2019 statutory performance comparison also reports on the average length of time per year that the customer is without water. On average, the total interruption time in 2019 is 18:19 minutes per connection. In addition to faults (unplanned interruptions), interruptions are also caused by planned maintenance (planned interruptions).

Figure 4.3 Service score

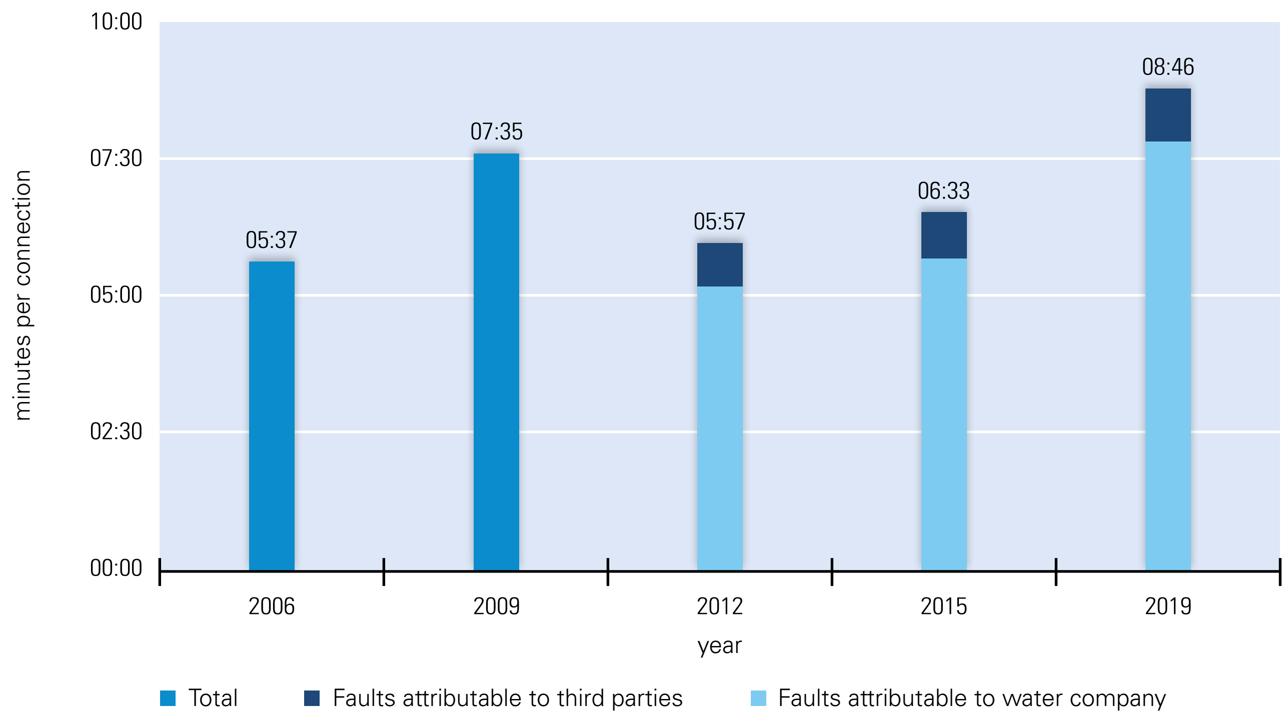


In 2019, the average interruption time due to faults (unplanned) is 8:46 minutes (Figure 4.4). This relatively high outcome is related to a few incidents that occurred in that year involving transport pipelines and pumping stations, as a result of which many connections were without water for some time. A total of 0:57 minutes of interruption time was caused by damage to the network due to excavation work by third parties. The average interruption time due to regular maintenance (planned) is 9:33 minutes (Figure 4.5).

4.1.4 Continuity in case of emergencies

Certain processes are vital to Dutch society to the extent that failure or disruption can lead to serious social disruption and pose a threat to national security. The drinking water supply is part of the infrastructure in the Netherlands deemed most vital.

Figure 4.4 Delivery interruption time due to faults

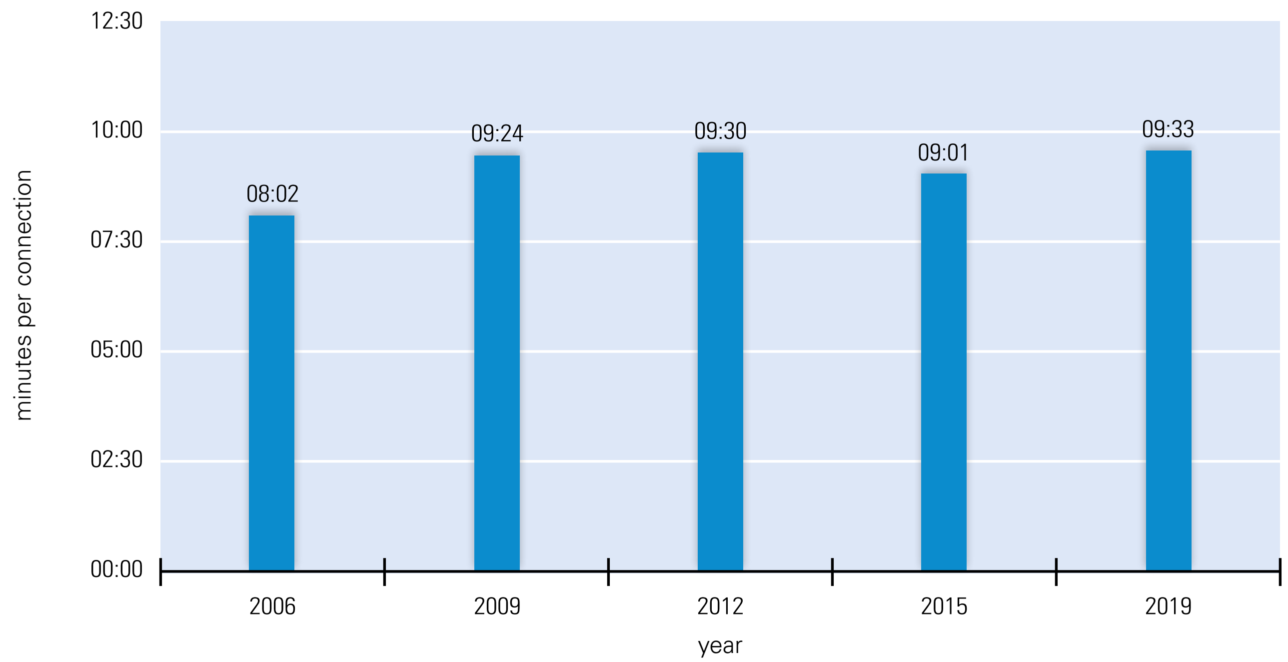


(ILT, 2020)

The drinking water companies have a legal obligation to supply. For example, in the event of a power cut, it must be possible to continue the drinking water supply for another ten days. If the supply of drinking water via the mains network fails for more than 24 hours, drinking water companies must organise an emergency drinking water supply that provides citizens with at least 3 litres of emergency drinking water per person per day.

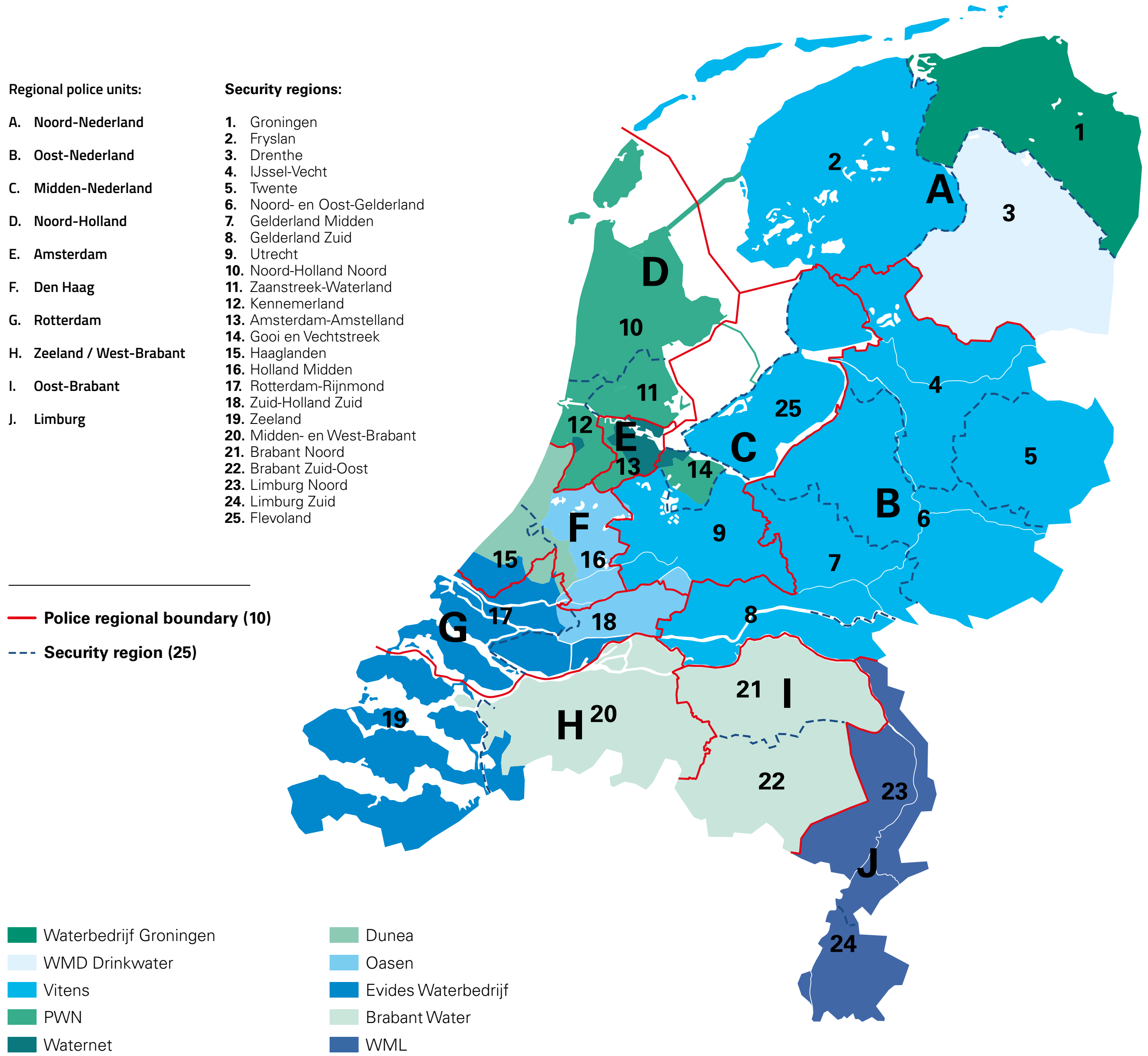
In the event of drinking water-related emergencies, collaboration and coordination between drinking water companies, security regions and police units is vital. This includes informing each other in good time about (imminent) incidents that could affect the drinking water supply and organising the response to it. Figure 4.6 provides an overview of the 10 distribution areas, the 25 security regions and the 10 police units.

Figure 4.5 Delivery interruption time due to planned maintenance



(ILT, 2020)

Figure 4.6 Distribution areas, security regions and police units



4.2 Sustainability

Drinking water companies abstract, treat and distribute water. On the one hand, the sector is dependent on the surrounding nature and the environment for the raw material. On the other hand, parts of the operations affect the environment. The drinking water companies aim to keep their footprint as small as possible by striking a sustainable balance between water extraction, nature management and their environmental policy. For example, nature conservation areas are managed ecologically and, in the context of combating desiccation, production volumes have been reduced or production sites moved to areas that are not prone to desiccation. The drinking water companies also pursue a sustainable procurement policy. In addition, day-to-day operations are powered by renewable energy combined with the aim to minimise energy consumption (§ 4.3) and water losses (§ 4.2.1). Furthermore, the drinking water is softened (§ 4.2.2) while the residual materials from drinking water production are reused (§ 4.2.3).

4.2.1 Non-revenue water

NRW is the difference between the amount of drinking water that the drinking water companies have pumped into the mains network in a year and the amount invoiced to the customers. In the statutory performance comparison of drinking water companies, ILT applies NRW as a measure for water losses during distribution and transport. In addition to actual water losses, NRW accounts for use that has not been billed, illegal tapping and measurement differences. § 3.5.2 (Figure 3.10) shows the development of NRW over time.

From a sustainability point of view, the drinking water companies aim for the lowest possible water losses. NRW has risen slightly in recent years and in 2020 will amount to 6.0% of total water demand. Part of the increase is probably related to the heat and drought in recent years. Drought and desiccation can cause the soil to settle, causing leaks (ILT, 2020). Converted per km of pipeline, NRW in 2020 will be 1.7 m³/km/day.

Compared to other European countries, NRW in the Netherlands is low. International data from EurEau, the European interest group for drinking water supply and wastewater treatment, shows that the percentage of NRW in the Netherlands (6%) is one of the lowest in Europe. The average percentage among European countries surveyed by EurEau is 25% (§ 7.2.3).

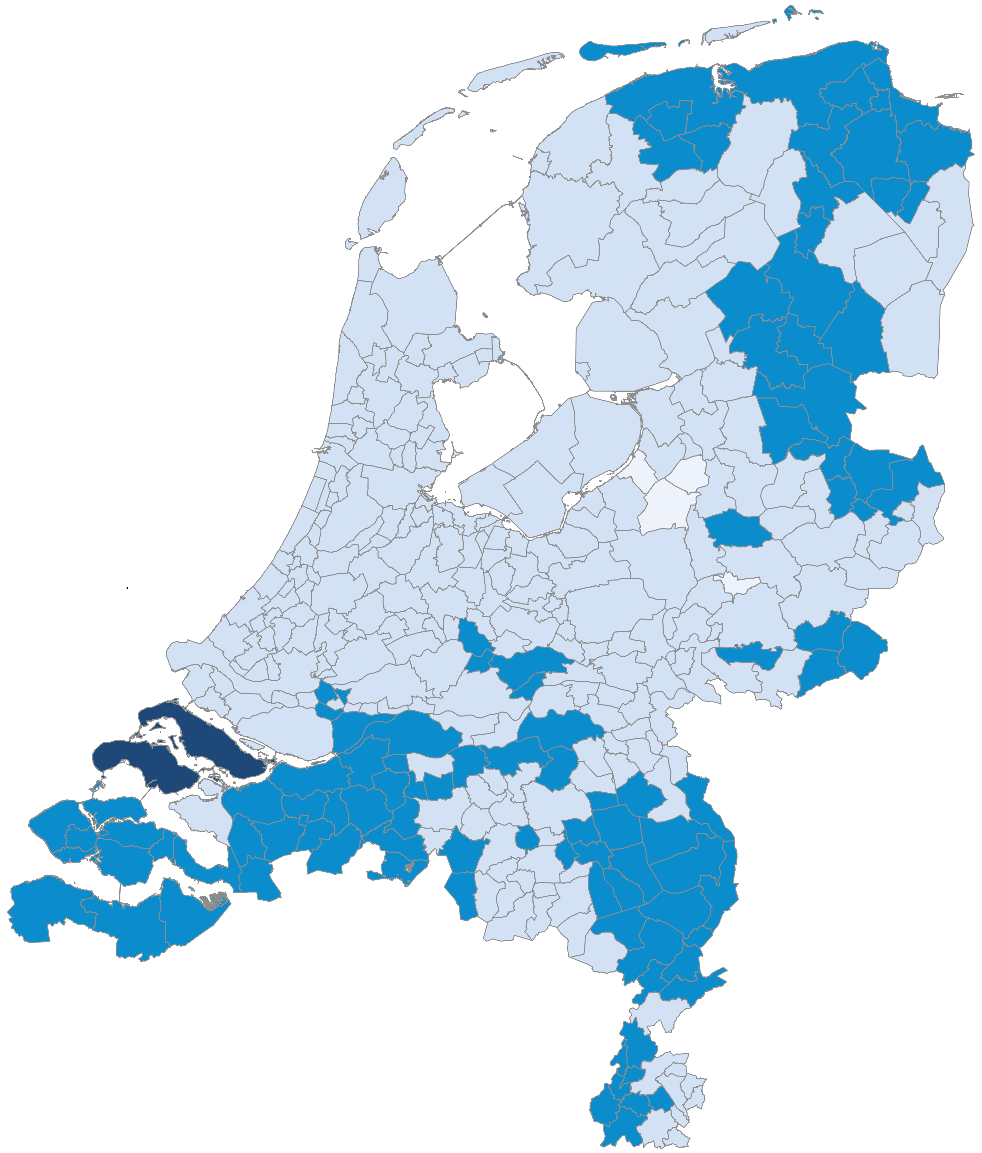
4.2.2 Water hardness

Hard water is water that contains a lot of calcium and magnesium. The Dutch drinking water companies use different water sources for the preparation of drinking water. The content of calcium and magnesium differs per source (depending on the soil composition, among other things) and therefore the water hardness of the sources differs per region. This means that drinking water hardness differs per region as well. Figure 4.7 shows this hardness per region.

The drinking water companies soften the drinking water via an extra step during the treatment process. The advantage of softening is that less limescale occurs when the drinking water is heated, such as in a kettle and in the bathroom. Soft water is therefore good for the service life of all kinds of household appliances. In addition, less detergent is needed when washing.

Softening increases energy consumption and the climate footprint of the drinking water production (more chemicals, more energy, more plants). However, this is recouped at the customer thanks to a reduction in the climate footprint through savings in energy and detergent use and a longer service life of the equipment.

Figure 4.7 Hardness of Dutch drinking water in 2020



Average hardness per municipality

- Very soft (maximum 0.71 mmol Ca^{2+} and Mg^{2+} per litre)
- Soft (>0.71 - 1.43 mmol Ca^{2+} and Mg^{2+} per litre)
- Average (>1.43 - 2.14 mmol Ca^{2+} and Mg^{2+} per litre)
- Moderately hard (>2.14 - 2.39 mmol Ca^{2+} and Mg^{2+} per litre)

(KWR, 2021)

4.2.3 Reuse of residual materials

The production of drinking water releases residual substances such as sludge, lime granules and aquafer. These drinking water residues have long ceased to be regarded as waste, but as valuable raw materials. As a result, primary raw materials are preserved.

AquaMinerals, formerly Restoffenunie, was founded by the Dutch drinking water companies 26 years ago to look for new destinations for residual materials from drinking water production. This joining of forces makes the drinking water sector one of the pioneers in the field of the circular economy. De Watergroep, a Flemish water company, joined AquaMinerals in 2015. In 2017, the Articles of Association were amended to allow the participation of water authorities. The first water authorities joined in 2018 and since then, AquaMinerals markets raw materials from the entire water chain.

In 2020, AquaMinerals disposed of a total of 236,812 tons of Dutch drinking water residuals. No less than 99.7% of this through useful application. Table 4.3 provides an overview of this by type of product.

Table 4.4 also shows the applications per type of product. Lime granules, which are formed during the softening of drinking water, are used as filler in the backing of carpet tiles for example. Lime granules are also used in glass production, concrete manufacturing and for insulation purposes, as well as in the form of lime fertiliser in agriculture and horticulture.

Table 4.3 Drinking water residues disposed of by AquaMinerals in 2020 by type of product

Product	Quantity	Useful applications	
	tonnes	*tonnes*	*%*
Lime granules	84,361	84,361	100
Aquafer	88,248	87,740	99.4
- dewatered aquafer	23,158	22,718	98.1
- liquid aquafer	65,090	65,022	99.9
Sludge	54,195	54,049	99.7
- aluminium sludge	15,428	15,428	100
- iron/lime sludge	21,792	21,792	100
- carbon sludge	4,755	4,755	100
- active carbon	146	0	0
- river sediment	10,440	10,440	100
- lagoon bed sludge	1,634	1,634	100
Granulate			
- filter sand and gravel	10,008	10,008	100
Sector	236,812	236,157	99.7

(AquaMinerals, 2020)

Table 4.4 Applications for Dutch drinking water residues disposed of by AquaMinerals, 2020

Product	Tonnes
Active carbon	**146**
- landfill	146
Aluminium sludge	**15,428**
- public space / infrastructure (construction)	15,428
Filter gravel	**10,008**
- public space / infrastructure (construction)	10,008
Iron/lime sludge	**21,792**
- public space / infrastructure (construction)	49
- agriculture and horticulture	20,725
- storage [1]	1,018
Lime granules	**84,361**
- production of concrete (concrete products)	10,625
- surface insulation / housing (insulation)	20,593
- composite / filler	33,435
- glass manufacture / industrial packaging glass	6,238
- aquaria-terraria / animal husbandry	2,071
- public space / infrastructure (construction)	29
- lime industry	243
- agriculture and horticulture	4,672
- storage [1]	3,412
- water treatment / cleantech (water)	3,043
Carbon powder	**4,755**
- public space / infrastructure (construction)	4,755
River sediment	**10,440**
- production of concrete (concrete products)	7,529
- public space / infrastructure (construction)	2,911
Dewatered aquafer	**23,158**
- generation of energy (biobased)	10,921
- generation of energy (VFG)	450
- public space / infrastructure (construction)	433
- agriculture and horticulture	222
- storage [1]	10,692
- landfill	440
Lagoon bed sludge	**1,634**
- public space / infrastructure (construction)	1,634
Liquid aquafer	**65,090**
- generation of energy (biobased)	17,839
- generation of energy (VFG)	4,142
- generation of energy (domestic waste)	10,960
- public space / infrastructure (construction)	192
- agriculture and horticulture	584
- organic fertiliser	1,293
- storage [1]	24,456
- landfill	68
- water treatment / cleantech (water)	5,555
Sector	**236,812**

Remainder of table on next page.

1) Temporary storage pending useful application.

(AquaMinerals, 2020)

4.3 Energy transition

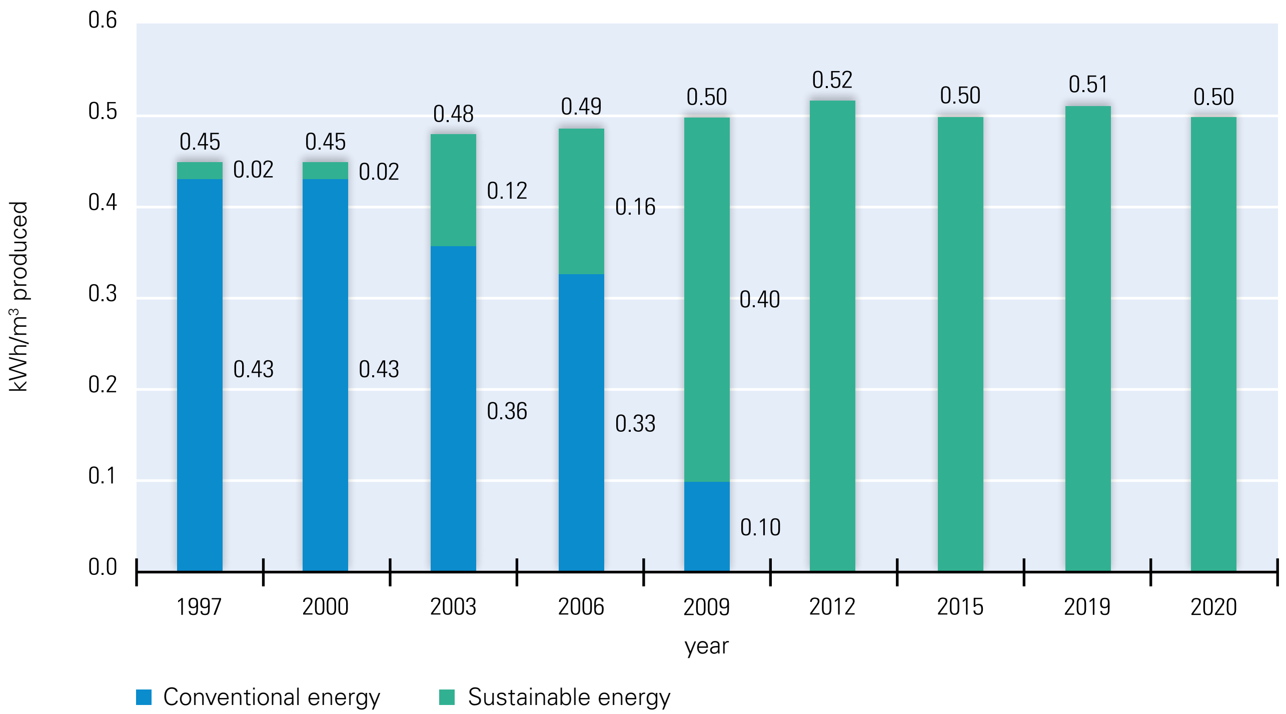
Due to an increase in CO_2 and other greenhouse gases in the atmosphere, the average temperature is rising. As a result, weather extremes increase, such as more frequent periods of extreme heat and drought and, on the other hand, more frequent occurrences of extreme precipitation (§ 2.1). In order to limit global warming to less than 2 degrees Celsius (the aim is 1.5°C), climate goals were agreed in 2015 in the Paris Agreement with measures being agreed in the Netherlands in the 2019 Climate Agreement to achieve these goals. The transition from conventional energy to renewable energy is to reduce greenhouse gas emissions by 49% in 2030 compared to 2019 levels and by 95% in 2050.

In the context of the energy transition, reducing and making energy consumption more sustainable and reducing the CO_2 footprint are important objectives of the drinking water companies.

4.3.1 Energy consumption

Figure 4.8 shows the development of electricity consumption for production and distribution per m^3 of drinking water produced. In the period between 1997 and 2012, energy consumption increased by approximately 15% due to the addition of extra treatment steps for the removal of undesirable substances (such as pesticides, pharmaceutical residues and endocrine disrupting substances) and due to the expanding of the treatment processes with softeners. Between 2012 and 2015, energy consumption fell from 0.52 kWh per m^3 drinking water produced to 0.50 kWh/m^3, partly by replacing some older treatment plants with more energy-efficient plants. Electricity consumption has since remained approximately the same at 0.50 kWh/m^3.

Figure 4.8 Development of electricity use for production and distribution



Although the Water Framework Directive should ensure that the quality of the sources improves, the opposite is the case (§ 2.2). The treatment effort and the associated energy demand are increased by an increased palette of undesirable substances in the drinking water sources. On the other hand, the drinking water companies continue to look for opportunities to save energy, such as by deploying energy-efficient plants and by optimising the water pressure.

4.3.2 Use of renewable energy

Between 1997 and 2012, the share of renewable electricity used increased from 4% to 100% and has remained 100% since. The drinking water companies also increasingly generate their own renewable energy. In 2015, the amount of self-generated renewable electricity was still 0.8 GWh, but in 2020 this increased to 14.9 GWh. That is 2.4% of the total electricity used for production and distribution. The drinking water companies also make their sites available to third parties for the purpose of sustainable power generation. An example of this are floating solar panels in the water basins of Evides.

In addition, various initiatives are under way at the drinking water companies to extract energy from drinking water or from the water from which drinking water is prepared. This can be achieved by means of a TED system (thermal energy from drinking water). Heat is extracted from the drinking water (or from the water still to be treated) by means of a heat exchanger and used for heating purposes. The energy obtained can be used directly or stored in the ground by means of Aquifer Thermal Energy Storage (ATES) (§ 6.4). Heat can also be added to the water for cooling purposes. The latter principle is applied at, for example, the “Mall of the Netherlands” shopping centre in Leidschendam-Voorburg, which is (partly) cooled with water from a river water supply pipe of drinking water company Dunea.

An important condition in TED is that the quality of drinking water is not adversely affected. The Drinking Water Act stipulates a legal temperature requirement for drinking water of maximum 25°C. Therefore, when using TED for cooling, measures must be in place to ensure that the drinking water only heats up to a limited extent. When using TED for heating purposes, the temperature of the drinking water drops, which in warm periods can help meet the maximum requirement of 25°C.

Making energy consumption more sustainable is an important objective of the drinking water companies. When integrating into the spatial environment, the continuity of the supply of high-quality drinking water must be guaranteed. This applies not only to TED, but to geothermal energy and ground energy systems in general. These forms of energy are discussed in more detail in the chapter on soil and subsoil (Chapter 6). As in TED, measures must be in place to ensure that drinking water does not heat up unintentionally either. In addition, drinking water sources becoming contaminated must be prevented as well.

5 The water chain

This chapter starts with a description of the components of the water chain (§ 5.1). Sewerage management by municipalities (§ 5.2) and public sewage treatment by the water authorities (§ 5.3) are discussed in more detail thereafter. In § 5.4 collaboration in the chain is discussed. The chapter is concluded with an overview of private wastewater treatment (§ 5.5).

5.1 Who does what in the water chain?

The entire chain of drinking water production, sewerage and wastewater treatment is called the water chain. The three main players in the water chain are the drinking water companies, the municipalities and the water authorities.

The drinking water companies supply the drinking water to households and companies. After use, it is discharged as wastewater through the sewer. The municipalities are responsible for the collection of the wastewater (often including rainwater) via the sewage system and the water authorities are responsible for the wastewater treatment in sewage treatment plants (STPs), also known as wastewater treatment plants (WWTPs). Before discharging, many companies pre-treat their wastewater in private WWTPs.

After treatment in the STP, the clean water, also called effluent, is discharged into the surface water and returns to the water system. The water authorities and the Directorate-General of Public Works and Water Management manage the water system and take measures to ensure the best possible water quality. Drinking water companies close the water chain because they in turn abstract water from the water system as a source for drinking water preparation. Figure 5.1 visualises the water chain.

Figure 5.1 The water chain

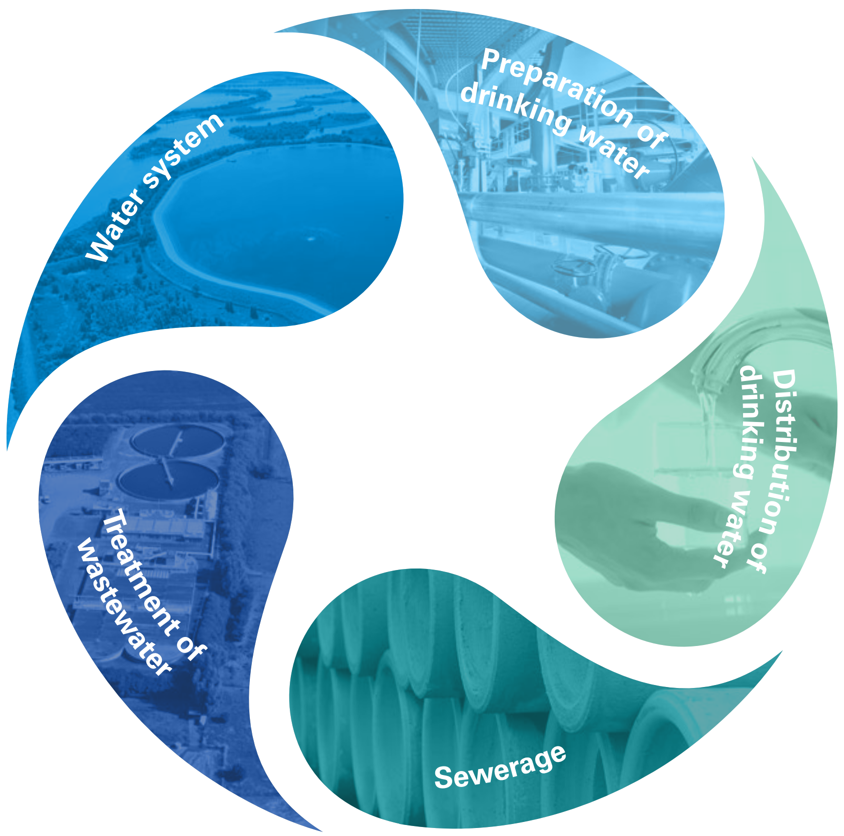


Table 5.1 Drinking water supply and sanitation in the Netherlands [1]

	Drinking water	Wastewater		Total
		collection	*treatment*	
Operators [2]	10	352	21	383
Population connected (%)	100%	99.5% [3]	99.5%	
Supplied drinking water and treated waste water				
million m^3	1,159		1,936 [4]	
m^3 per inhabitant per year	66		111	
litres per inhabitant per day	181		303	
Network (km)	120,244	140,600 [5]	8,000 [6]	268,844
Employees (FTE)	5,097	2,360 [7]	1,783 [8]	9,240

1) Reference date for drinking water is 2020, reference date for sewage data varies.

2) Drinking water companies, municipalities (wastewater collection) and water authorities (wastewater treatment) as at 2021.

3) 99.9% if decentralised services are included.

4) Association of Regional Water Authorities. (2021). Waves databank (figures Waterschapsspiegel 2020).

5) RIONED Foundation. (2016). Het nut van stedelijk waterbeheer.

6) Association of Regional Water Authorities. (2021). Waves databank (figures Bedrijfsvergelijking Zuiveringsbeheer 2018).

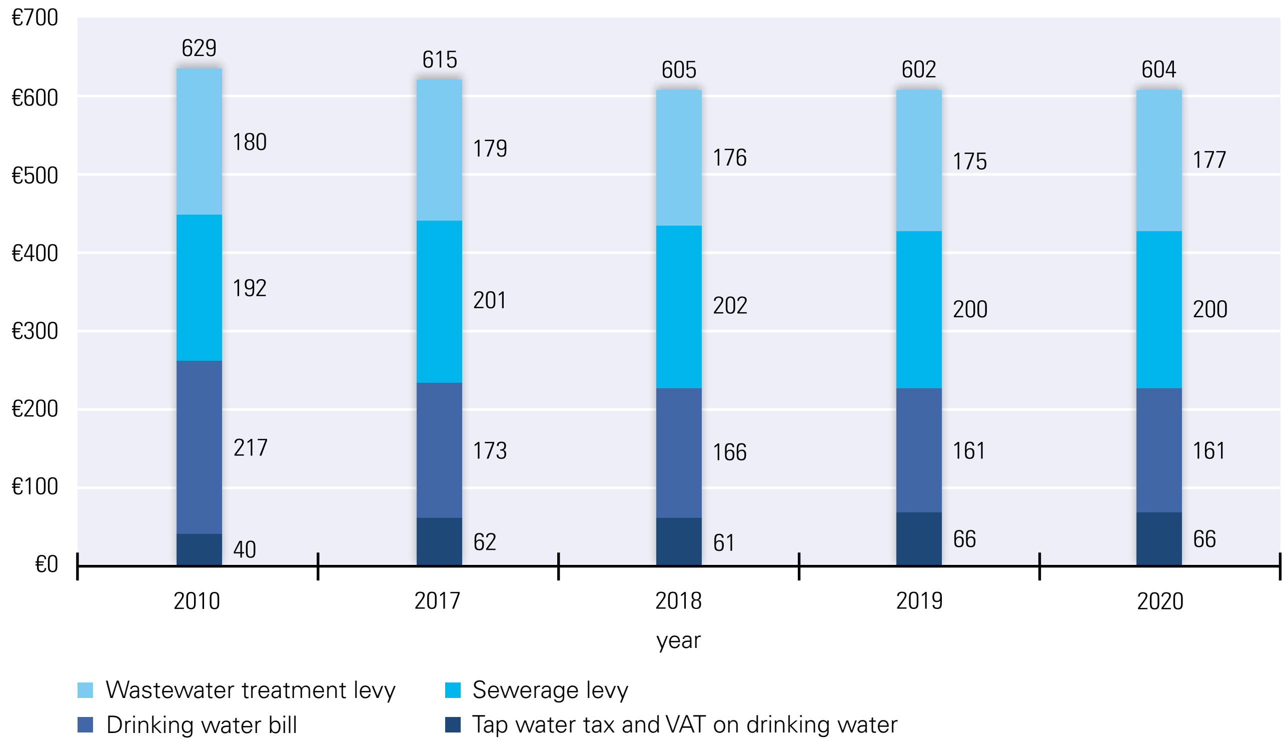
7) RIONED Foundation. (2013). Riolering in beeld 2013.

8) Association of Regional Water Authorities. (2021). Waves databank (FTEs budgeted for wastewater, figures Bedrijfsvergelijking zuiveringsbeheer 2018).

Table 5.1 shows a number of key figures for the drinking water and sanitation facilities in the Netherlands. Practically the entire Dutch population is connected to the public sewage system and the drinking water network. This involves a total of 383 municipalities, water authorities and drinking water companies. The wastewater is collected by 352 municipalities, the wastewater is treated by 21 water authorities and the drinking water is supplied by 9 single drinking water companies and one water cycle company. The latter company is Waternet, which is responsible for the entire water chain in and around Amsterdam.

Figure 5.2 shows the real development of the average bill for drinking water, sewerage and sewage treatment for a single-child family living in an owner-occupied home (amounts at 2020 price level). Partly as a result of the Administrative Agreement on Water Affairs (BAW, see § 5.4), real costs have fallen over the past decade. The rise in expenses slightly exceeded inflation for the first time in 2020.

Figure 5.2 Development of the water and sewer bill for a single-child family in an owner-occupied home (price level 2020)



(IenW et al., 2021)

5.2 Collection and transport of wastewater by municipalities

5.2.1 Population connected to sewage system

Practically the entire population is connected to the sewage system (Table 5.2), more than 95% of which is connected to gravity sewers. Based on this principle, sewage automatically flows from high to low. In addition, 4.1% is connected to mechanical sewage, of which pressure sewage system is the most common. A pressure sewage system is mainly used in rural areas to transport sewage over long distances. Furthermore, 0.4% of households rely on individual wastewater treatment (IBA).

5.2.2 Types of sewage systems

Table 5.3 provides an overview of the different types of sewage systems. Most wastewater is discharged mixed with rainwater (mixed sewer system). Rainwater is increasingly disconnected from the mixed sewer system and discharged directly to the surface water via a separate system. A special type is the 'improved separated system', which is fitted with thresholds at the discharge openings and a drainage pump, which transports the rainwater from small showers to a STP. During large showers, most of the rainwater is discharged to the surface water.

The water authorities pump the sewage collected by municipalities to the STPs through pressure pipes. The Netherlands further accommodates 12,500 km of drainage pipes for the removal of excess water from the soil and 6,000 km of other rainwater facilities, such as swales, gutters, ditches and verges (RIONED Foundation, 2016).

5.2.3 Discharge points

Not all water that enters the public sewage system reaches the STPs. During heavy rainfall, the sewer system can overflow, allowing water to be discharged into the surface water via an overflow point. The Netherlands has a total of approximately 53,000 discharge points, of which 13,000 overflow points in mixed sewers and 40,000 overflow points and discharge openings in rainwater sewers (RIONED Foundation, 2016).

Table 5.2 Number and share of households per type of sewage system

	Households connected x 1,000	%
Gravity flow sewerage	7,366	95.4%
Mechanical sewerage	317	4.1%
Individual treatment installation (IBA)	31	0.4%
Not connected to sewerage system	8	0.1%
Total in the Netherlands	7,721	100%

(RIONED Foundation, 2016)

Table 5.3 Network length per type of sewage system

	Network length km pipework	%
Mixed sewage system	50,000	33.6%
(improved) separate sewage system	48,000	32.3%
Pressure sewage system	29,000	19.5%
Other rainwater provisions	6,000	4.0%
Pump mains [1]	15,600	10.5%
Total for the Netherlands	148,600	100%

1) 7,600 km managed by municipalities and 8,000 km by water authorities.

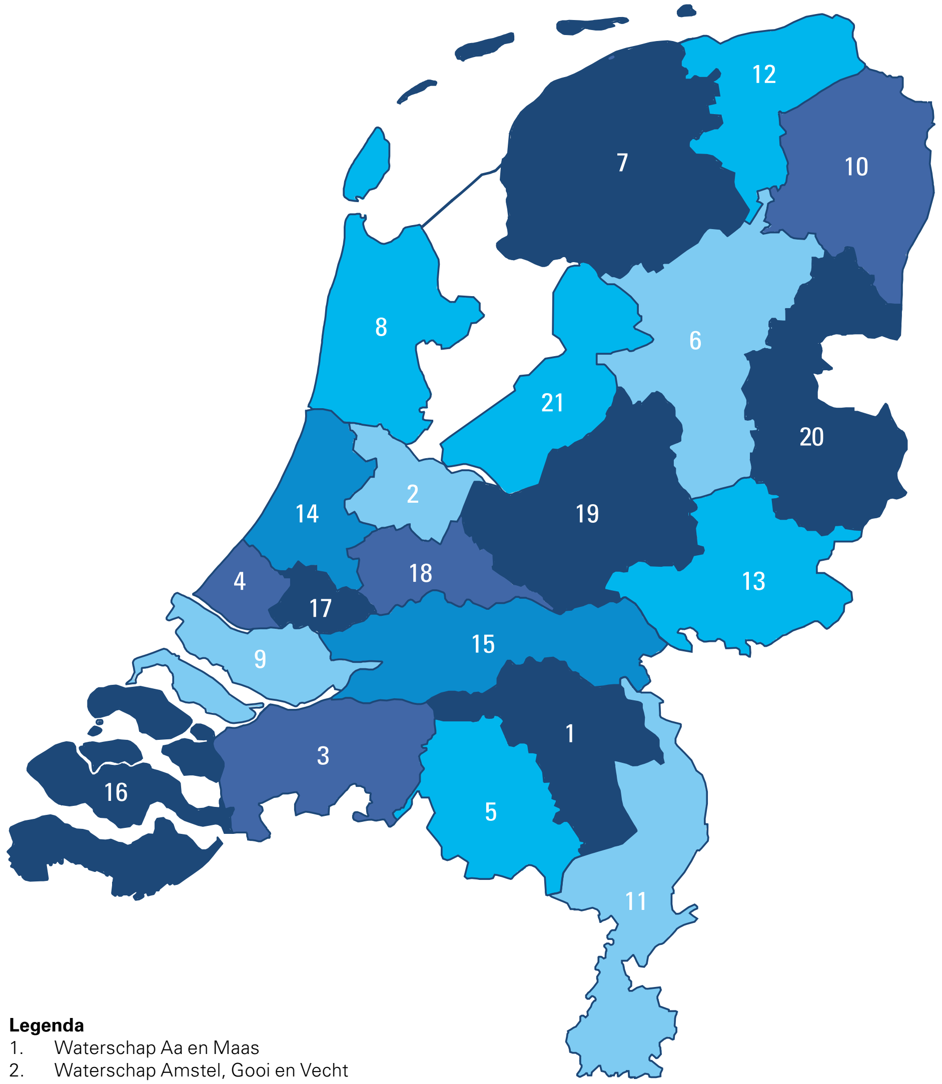
(RIONED Foundation, 2016)

5.3 Treatment of wastewater by the water authorities

5.3.1 Service areas

The water authorities are responsible for treating the wastewater. The wastewater collected via the sewage system is treated in STPs. In 2021, a total of 21 water authorities operate in the Netherlands. Figure 5.3 shows the service area of each water authority.

Figure 5.3 Water authorities service areas 2021



Legenda
1. Waterschap Aa en Maas
2. Waterschap Amstel, Gooi en Vecht
3. Waterschap Brabantse Delta
4. Hoogheemraadschap van Delfland
5. Waterschap De Dommel
6. Waterschap Drents Overijsselse Delta
7. Wetterskip Fryslân
8. Hoogheemraadschap Hollands Noorderkwartier
9. Waterschap Hollandse Delta
10. Waterschap Hunze en Aa's
11. Waterschap Limburg
12. Waterschap Noorderzijlvest
13. Waterschap Rijn en IJssel
14. Hoogheemraadschap van Rijnland
15. Waterschap Rivierenland
16. Waterschap Scheldestromen
17. Hoogheemraadschap van Schieland en de Krimpenerwaard
18. Hoogheemraadschap De Stichtse Rijnlanden
19. Waterschap Vallei en Veluwe
20. Waterschap Vechtstromen
21. Waterschap Zuiderzeeland

(UvW, 2020)

Table 5.4 Key figures of the water authorities, 2020

Water authority	Residents in service area	Municipalities [1]	Provinces [1]	Total surface area	Share of land	Share of water
	number	*number*	*number*	*hectare*	*%*	*%*
Aa en Maas	762,041	25	1	161,007	96	4
Amstel, Gooi en Vecht	1,310,372	19	3	70,189	85	15
Brabantse Delta	827,571	22	2	170,744	94	6
De Dommel	900,249	32	1	151,000	98	2
De Stichtse Rijnlanden	880,000	20	2	83,015	94	6
Delfland	1,190,000	14	1	40,821	93	7
Drents Overijsselse Delta	625,561	22	2	255,105	94	6
Fryslân	659,013	19	2	346,000	91	9
Hollands Noorderkwartier	1,165,000	30	1	196,700	93	7
Hollandse Delta	870,489	13	1	102,400	96	4
Hunze en Aa's	424,000	15	2	207,000	97	3
Limburg	1,115,895	31	1	220,985	96	4
Noorderzijlvest	383,000	11	3	144,000	87	13
Rijn en IJssel	650,000	21	2	194,945	99	1
Rijnland	1,285,497	30	2	108,896	88	12
Rivierenland	1,023,158	27	4	201,000	93	7
Scheldestromen	385,459	13	2	190,273	86	14
Schieland en de Krimpenerwaard	603,568	9	1	35,108	89	11
Vallei en Veluwe	1,120,000	37	3	245,633	97	3
Vechtstromen	859,000	23	3	225,800	98	2
Zuiderzeeland	416,431	8	3	241,846	60	40

1) Municipalities and provinces sometimes fall under multiple water authorities.

(UvW, 2021a)

Table 5.4 shows a number of general key figures for each water authority. Some water authorities have outsourced all or part of their wastewater treatment tasks to third parties. In the Amstel Gooi en Vecht service area, Waternet treats the wastewater. Delfluent BV treats part of the wastewater from the Delfland Water Authority service area. At Waterschap Limburg, the wastewater is treated by Waterschapsbedrijf Limburg (WBL), a subsidiary.

Table 5.5 Sewage treatment per water authority [1)]

	STPs	Supply of sewage	Capacity	Rate per pollution unit
	number	*1,000 m³*	*1,000 p.u.*	*€ / p.u.*
Aa en Maas	7	101,759	1,534	49
Amstel, Gooi en Vecht	11	129,186	2,023	55
Brabantse Delta	17	97,388	1,296	58
De Dommel	8	106,450	1,448	50
De Stichtse Rijnlanden	16	79,626	1,361	64
Delfland	4	137,102	1,784	94
Drents Overijsselse Delta	16	61,299	1,160	57
Fryslân	27	91,459	1,380	58
Hollands Noorderkwartier	15	104,297	1,713	55
Hollandse Delta	20	140,579	1,812	62
Hunze en Aa's	13	37,247	619	74
Waterschap Limburg	17	148,116	2,032	52
Noorderzijlvest	13	55,045	684	66
Rijn en IJssel	13	65,685	1,270	53
Rijnland	19	131,164	2,050	61
Rivierenland	33	108,577	1,622	55
Scheldestromen	15	50,169	799	62
Schieland en de Krimpenerwaard	9	54,192	655	50
Vallei en Veluwe	16	114,800	2,028	54
Vechtstromen	23	92,639	1,761	52
Zuiderzeeland	5	29,444	754	60

1) Reference year 2020 (UvW, 2021a), however, for capacity the reference year is 2019 (Statistics Netherlands, 2021).

5.3.2 Sewage intake agreements

Municipalities and water authorities make agreements about the volume of wastewater that is offered and processed. These agreements are laid down in Wastewater Agreements and/or in Municipal Sewerage Plans. If the sewage intake obligation is not met, sewage will end up in the surface water via an overflow point. In 2020, water authorities complied, on average, with 98.4% of the intake obligation (UvW, 2021b). In those instances where water authorities do not (or cannot) yet meet the obligations, they are working on adjustments or expansion of the wastewater transport system or STPs. Municipalities are also investigating whether the amount of wastewater that is collected via the sewer system can be reduced, for example by disconnecting rainwater (UvW, 2020).

5.3.3 Treatment of wastewater by water authority

Table 5.5 provides an overview per water authority of the number of STPs, their capacity and how much wastewater they have processed. In addition, the table shows the rate for wastewater treatment. In 2020, the Netherlands operated a total of 317 STPs, together processing nearly 2 billion m³ of wastewater. The total capacity of the STPs amounted to 29.8 million pollution units (p.u.) in 2019. One p.u. stands for the amount of oxygen-binding substances in the wastewater of a single person. The pollution unit is also used as a basis for calculating the pollution levy that households and businesses have to pay. A single-person household is levied with an assessment of 1 p.u. and multi-person households with 3 p.u. The starting point for businesses is that the number of p.u. is determined on the basis of the composition of the wastewater.

5.3.4 Zuiveringsprestaties Treatment performance

Table 5.6 shows the development of wastewater treatment for a number of parameters, including the treatment efficiencies. A number of important parameters are broken down further by river basin in Tables 5.7 and 5.8.

In 2020, the treatment performance, which indicates the extent to which the main waste materials (nitrogen, phosphorus, COD) are removed from the wastewater, amounted to 88.3% (UvW, 2021b).

The water authorities must meet the quality requirements set out in the Activities (Environmental Management) Decree for discharging effluent into surface water. Before the treated wastewater can be discharged, it must meet these requirements. The average compliance rate in 2020 was 99.2% (UvW, 2021b).

Table 5.6 Wastewater treatment in the Netherlands, 2010 - 2019

	2010	2015	2018	2019
Sewage treatment plants				
Number	349	334	323	317
Capacity (1,000 p.u.)	30,365	30,246	29,942	29,784
Volume treated (1,000 m³)	1,934,310	1,957,261	1,773,436	1,904,102
Supply of wastewater (influent)				
Chemical oxygen demand (1,000 kg)	953,490	999,309	1,016,606	1,002,491
Biochemical oxygen demand (1,000 kg)	370,007	405,787	426,326	427,966
Total nitrogen (1,000 kg)	87,866	89,122	94,116	94,209
Total phosphorous (1,000 kg)	13,880	13,389	13,307	13,555
Copper (kg)	145,405	144,556	138,509	.
Chrome (kg)	17,391	18,345	17,029	.
Zinc (kg)	460,409	425,519	438,978	.
Lead (kg)	36,893	35,770	36,314	.
Cadmium (kg)	803	570	405	.
Nickel (kg)	20,905	19,262	20,818	.
Mercury (kg)	319	243	210	.
Arsenic (kg)	6,295	7,182	6,659	.

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	2010	2015	2018	2019
Discharge of effluent				
Chemical oxygen demand (1,000 kg)	75,461	69,784	69,057	73,296
Biochemical oxygen demand (1,000 kg)	8,012	6,895	7,415	7,765
Total nitrogen (1,000 kg)	16,586	14,641	14,006	14,391
Total phosphorous (1,000 kg)	2,226	1,960	1,676	1,767
Copper (kg)	8,842	9,029	8,432	.
Chrome (kg)	2,897	2,234	2,463	.
Zinc (kg)	85,375	80,166	66,133	.
Lead (kg)	3,901	2,242	1,883	.
Cadmium (kg)	232	181	132	.
Nickel (kg)	9,367	7,695	7,946	.
Mercury (kg)	87	61	54	.
Arsenic (kg)	2,848	3,298	3,011	.
Treatment efficiency				
Chemical oxygen demand (%)	92	93	93	93
Biochemical oxygen demand (%)	98	98	98	98
Total nitrogen (%)	81	84	85	85
Total phosphorous (%)	84	85	87	87
Copper (%)	94	94	94	.
Chrome (%)	83	88	86	.
Zinc (%)	81	81	85	.
Lead (%)	89	94	95	.
Cadmium (%)	71	68	67	.
Nickel (%)	55	60	62	.
Mercury (%)	73	75	74	.
Arsenic (%)	55	54	55	.

(Statistics Netherlands, 2021)

Table 5.7 STPs by river basin, 2019

	STPs	Capacity	Volume treated
	number	*1,000 p.u.*	*1,000 m³*
Ems	16	1,134	75,107
Rhine-North	38	1,565	101,744
Rhine-East	73	6,885	359,539
Rhine-West	118	12,876	859,488
Meuse	52	6,021	420,740
Scheldt	20	1,302	87,485
The Netherlands	317	29,784	1,904,102

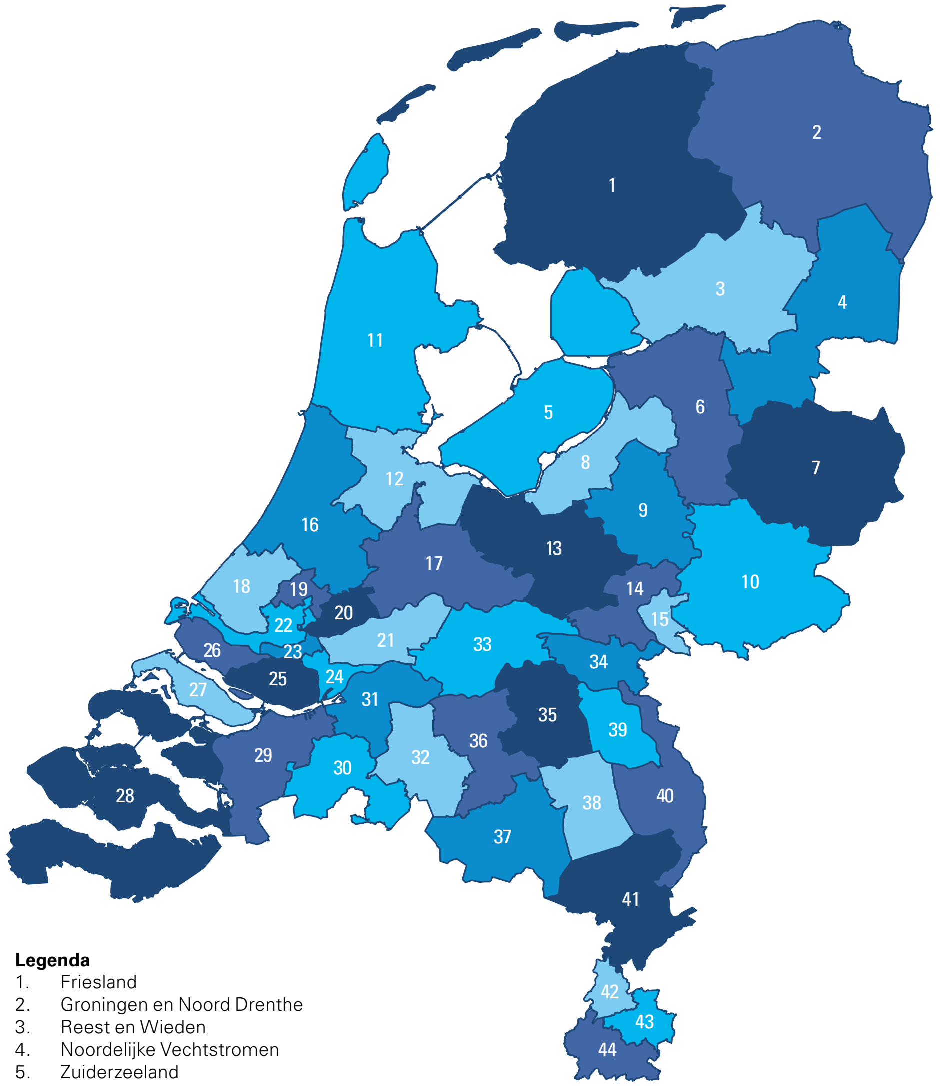
(Statistics Netherlands, 2021)

Table 5.8 Treatment results per river basin, 2019

River basin	Biochemical oxygen demand			Chemical oxygen demand			Nitrogen compounds as N			Phosphorous compounds as P		
	influent 1,000 kg	*effluent 1,000 kg*	*efficiency %*	*influent 1,000 kg*	*effluent 1,000 kg*	*efficiency %*	*influent 1,000 kg*	*effluent 1,000 kg*	*efficiency %*	*influent 1,000 kg*	*effluent 1,000 kg*	*efficiency %*
Ems	14,855	454	97	34,519	3,701	89	2,954	535	82	406	65	84
Rhine-North	18,157	334	98	44,506	4,127	91	4,310	490	89	621	85	86
Rhine-East	93,963	1,049	99	245,781	13,685	94	20,535	2,586	87	3,013	327	89
Rhine-West	191,796	3,317	98	411,925	31,108	92	42,740	6,584	85	5,835	810	86
Scheldt	92,064	2,130	98	224,086	16,554	93	19,692	3,370	83	3,085	354	89
Meuse	17,131	481	97	41,674	4,121	90	3,978	826	79	595	126	79
The Netherlands	427,966	7,765	98	1,002,491	73,296	93	94,209	14,391	85	13,555	1,767	87

(Statistics Netherlands, 2021)

Figure 5.4 Water chain collaboration regions



Legenda

1. Friesland
2. Groningen en Noord Drenthe
3. Reest en Wieden
4. Noordelijke Vechtstromen
5. Zuiderzeeland
6. Rivus
7. Twents Waternet
8. Noord Veluwe
9. Oost Veluwe
10. Achterhoek
11. Noorderkwartier
12. Amstel, Gooi en Vecht
13. Vallei en Eem
14. Rijn 6
15. Liemers
16. Rijnland
17. Winnet
18. Delfland
19. Kortenoord
20. Krimpenerwaard
21. Alblasserwaard - Vijfheeren-landen
22. Rotterdam
23. Barendrecht e.o.
24. Drechtsteden
25. Hoeksche Waard
26. Voorne Putten
27. Goeree Overflakkee
28. Zeeland
29. Waterkring west
30. Waterkring Baronie
31. Werkeenheid 4
32. Hart van Brabant
33. Rivierenland
34. Nijmegen
35. AS50+
36. Meijerij
37. Waterportaal Zuidoost Brabant
38. Peelgemeenten
39. Land van Cuijck
40. Venlo-Venray
41. Limburgse Peelen
42. Westelijke Mijnstreek
43. Parkstad
44. Maas en Mergelland

(Water Chain Assessment Committee, 2015)

5.4 Collaboration in the water chain

In 2011, the Dutch government concluded the Administrative Agreement on Water Affairs (BAW) with Vewin, the Association of Regional Water Authorities, the Association of Netherlands Municipalities (VNG) and the Association of Provincial Authorities (IPO). The term of the agreement was until 2020. As a result of the BAW, the water chain partners have started collaborating more intensively and steps have been taken in the field of efficiency, quality and reducing (staff) vulnerability.

There are a total of 44 regions in which drinking water companies, municipalities and water authorities work together regionally (Figure 5.4). The parties share knowledge and work together in projects. The shared insight into the state and functioning of the (sewage) chain leads to optimal management and investment decisions. Sometimes, joint organisational structures are set up for the collaboration (www.samenwerkenaanwater.nl, 2021).

Staff vulnerability occurs if, for example, only a single employee has certain expertise or skills or if many experienced employees retire in a short period of time. Knowledge exchange, joint knowledge development, specialisation in a regional context and staff exchanges will help to reduce vulnerability.

The collaboration has resulted in major efficiency gains. In 2011, within the context of the BAW, an annual efficiency gain target of EUR 450 million per year in 2020 was set (of which EUR 70 million in the drinking water sector). In 2019, the efficiency gain had risen to 668 million (of which EUR 148 million in the drinking water sector), well above the target. The efficiency improvement is attributed to increased efficiency, more intensive collaboration and improved asset management (IenW, 2021). In the BAW, goals have been set for the water chain, as well as for water system management. For the water system, the BAW target was an efficiency gain of EUR 300 million per year, whereas the realisation had risen to EUR 404 million per year in 2019, also well above the target.

5.5 Wastewater treatment by private companies

In addition to water authorities, a lot of wastewater is also treated by companies in private (industrial) WWTPs. Some of the companies discharge the effluent directly into the surface water and another part of the companies discharges the (pre-)treated water into the sewage system. The pre-treatment step means that these companies save on the treatment levy to be paid to the water authority.

Table 5.9 shows wastewater treatment at companies by industry. In 2015 Statistics Netherlands registered a total of 432 private treatment plants; of which 24 mechanical, 199 physico-chemical and 209 biological treatment plants (Statistics Netherlands, 2017a). The types of WWTPs range from small plants for the removal of heavy metals to large biological treatment plants for the removal of biodegradable substances. The total treatment capacity of the WWTPs is 13.8 million population equivalents (p.e.). This means that it is comparable to the treatment capacity of wastewater produced by 13.8 million inhabitants.

The destination of the effluent is diverse. The effluent from 72% of treatment plants is discharged into the sewage system and 19% of the treatment plants discharges into national waters. A total of 31 of the 432 treatment plants (or 7%) discharge into regional surface water and the effluent of 9 of the 432 treatment plants (2%) is reused (Statistics Netherlands, 2017b).

Table 5.9 Wastewater treatment at companies, 2015

Sector (SIC 2008)	Total WWTPs	Mechanical treatment	Physico-chemical treatment	Biological treatment	Capacity
	number	*number*	*number*	*number*	*1,000 p.e.*
A Agriculture, forestry and fishing	2	2	-	-	-
C Industry	350	21	173	156	10,720
10-12 Food, beverages and tobacco industry	131	2	37	92	6,616
13-15 Textile, clothing and leather industry	12	2	9	1	20
16+23 Wood and construction materials industry	8	2	5	1	20
17-18 Paper and graphics industry	21	2	9	10	821
19-22 Refinery and chemicals	74	6	25	43	2,790
24-25 Base metals and metal manufacturing industry	75	4	63	8	430
26-28 Electrical engineering and machinery industry	14	1	13	-	11
29-30 Modes of transport industry	10	1	8	1	11
31 Furniture industry	1	-	1	-	-
32 Other industry	2	1	1	-	-
33 Repair and installation of machinery	2	-	2	-	-
D Energy production and supply	10	-	6	4	166
E Water supply and waste management	33	1	7	25	1,142
F Construction industry	1	-	-	1	-
G-I Trade, transport and hospitality	24	-	9	15	199
K Financial services	1	-	-	1	5
L Rental and sales of real estate	1	-	-	1	100
M-N Business services	5	-	3	2	1,020
O-Q Government and healthcare	5	-	1	4	454
A-U All economic activities	432	24	199	209	13,805

(Statistics Netherlands, 2017a)

6 Soil, nature and subsoil

Land use above ground, including agriculture and industry, as well as the increasing activity in the subsoil, possibly pose risks to the drinking water supply. In addition to these possible threats, there are also opportunities for combinations or collaboration; for example, between drinking water and nature. This chapter first describes land use in the Netherlands (§ 6.1) and then provides information regarding nature and drinking water (§ 6.2), mining and drinking water (§ 6.3) and ground energy (§ 6.4).

Figure 6.1 Land use in the Netherlands, 2015

(Statistics Netherlands, PBL & WUR, 2020a)

6.1 Soil

6.1.1 Land use

The total surface area of the Netherlands, including inland waterways, amounts to 3.7 million ha. Figure 6.1 provides an overview of land use in the Netherlands in 2015. The use of space in the Netherlands in 2015 is further specified in figure 6.2.

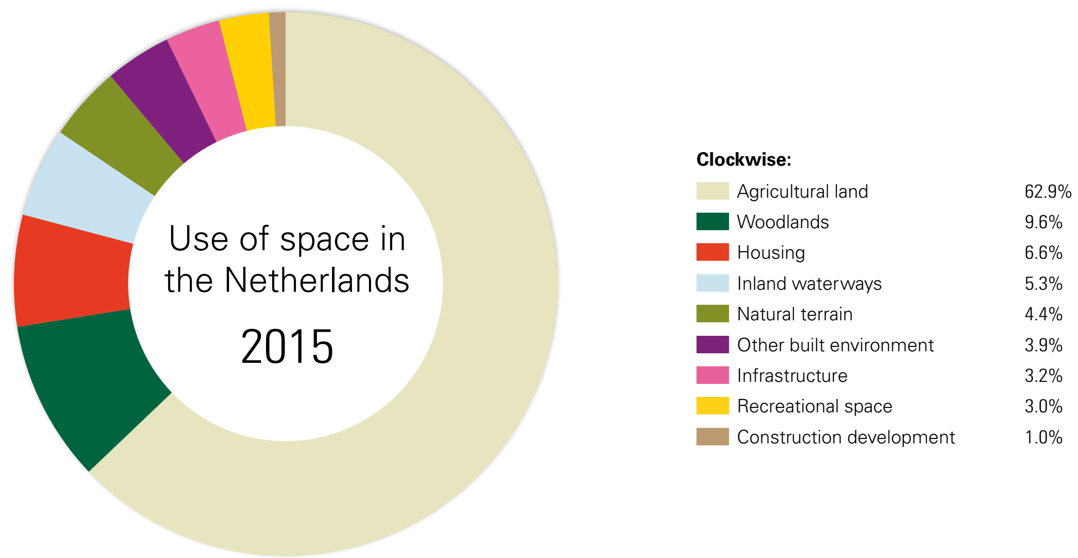
Over 5% of the Netherlands consists of inland water and 14% of forests and natural terrain. With 63%, the agricultural sector is by far the largest user of space in the Netherlands. About 15% of the total surface area is infrastructure, residential land, building land and other built-up land. The use of space differs strongly per region. Figure 6.1 shows a clear clustering of urban uses in the west of the Netherlands in the provinces of Brabant and South Limburg. The east and north of the Netherlands have considerably less urban development. The 2019 Regional Population and Household Forecast by the Netherlands Environmental Assessment Agency (PBL) and Statistics Netherlands shows that the population of the four major cities (Amsterdam, Utrecht, The Hague and Rotterdam) will continue to grow strongly in the coming decades, whereas smaller municipalities on the outskirts of the Netherlands will continue to shrink or remain the same in terms of population size (Statistics Netherlands, 2019).

Most water extraction sites (see figure 3.2) are located in or near nature conservation areas, but sometimes also in agricultural areas or even in the middle of the city.

6.1.2 Soil settlement and subsidence

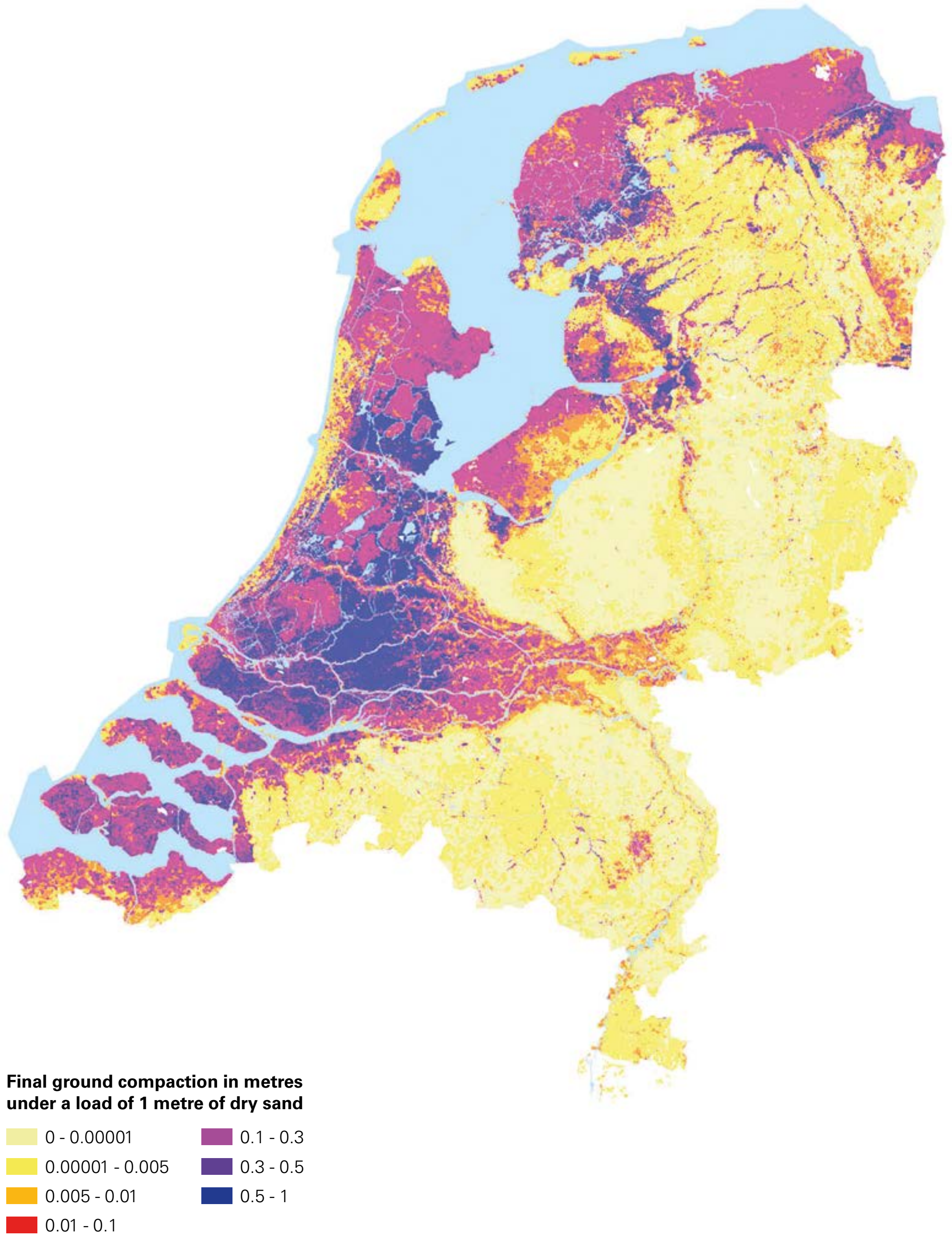
Soil settlement is the degree of subsidence as a result of load on the soil. When the soil subsides relative to a certain reference point, for example Amsterdam Ordnance Datum, it is referred to as subsidence. Soil settlement and subsidence can lead to damage to homes and infrastructure, including water pipes. Underground water pipes run a high risk of pipe bursts in areas of sharp transitions between little and much subsidence (Besten, Maccabiani & Maljaars, 2014). Deltares and Netherlands Organisation for Applied

Figure 6.2



(Statistics Netherlands, PBL & WUR, 2020)

Figure 6.3 Soil settlement

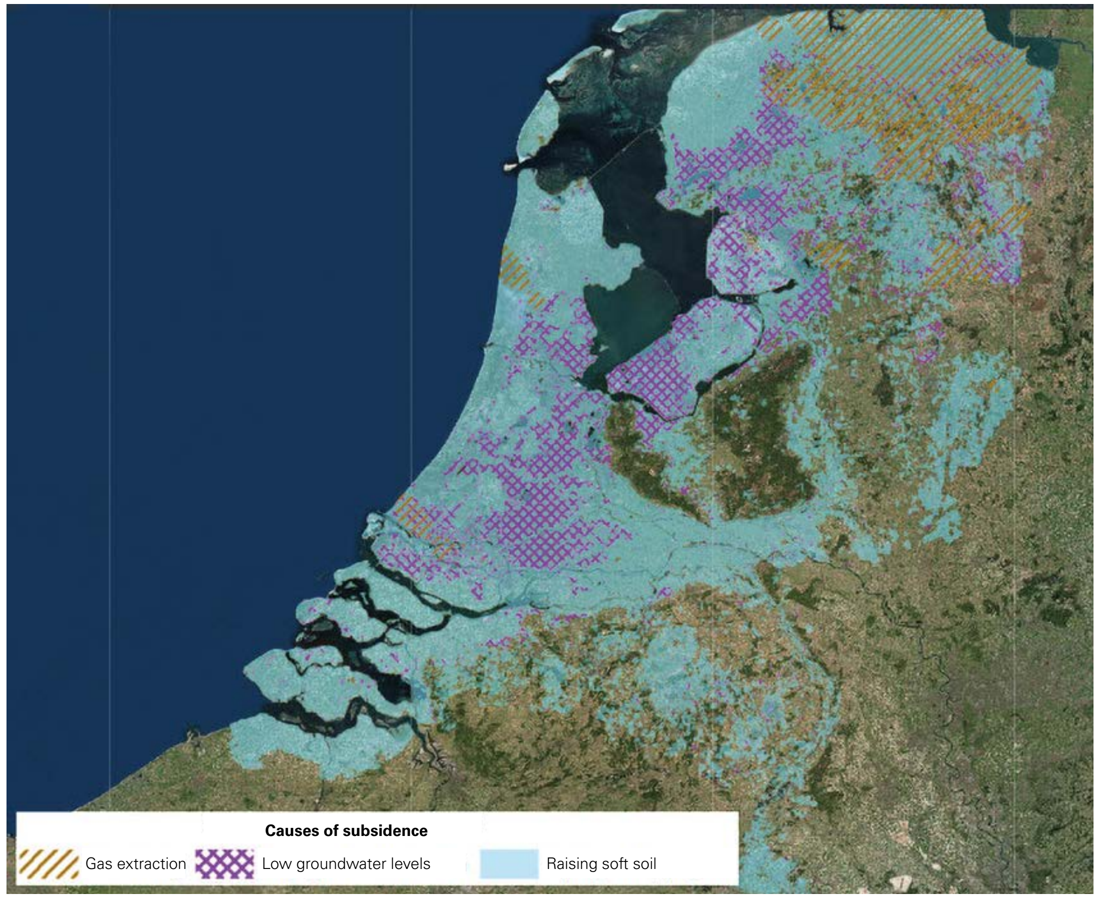


(Deltares & TNO, 2012)

Scientific Research (TNO) have mapped out how sensitive the soil is to settlement in the Netherlands (see figure 6.3). The sensitivity to settlement strongly depends on the soil composition. Settlement mainly occurs in peat and clay areas, which means that extra measures are needed in such areas to limit pipe bursts.

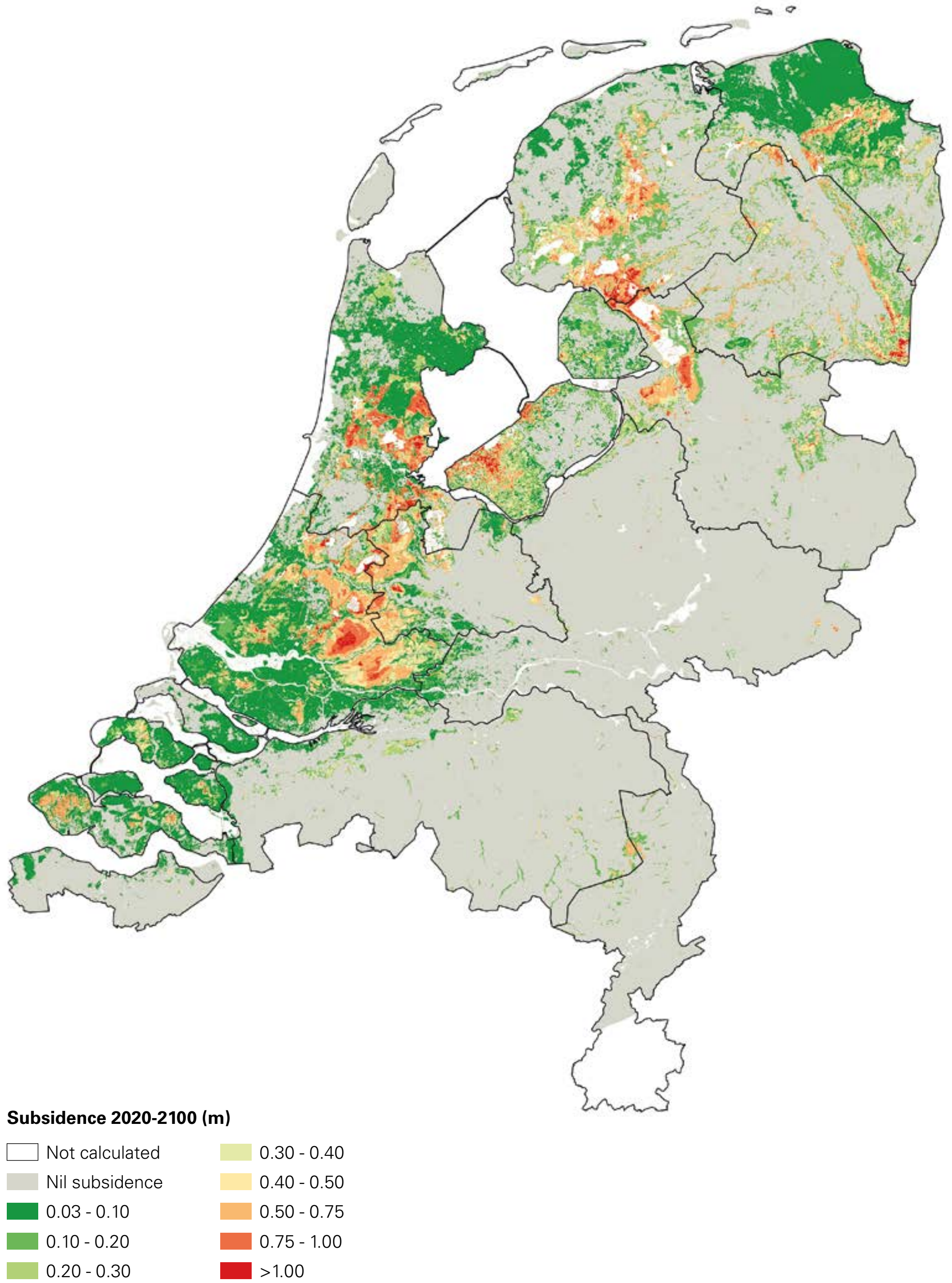
Deltares has investigated the main causes of subsidence in the Netherlands and how subsidence will develop regionally in the coming decades. Mineral extraction (particularly natural gas), low groundwater levels and the raising of soil with sand are the main causes of (local) subsidence in the Netherlands (Deltares, 2017). Figure 6.4 shows the causes of subsidence per region. Figures 6.5 and 6.6 show scenarios for subsidence in 2100 with and without additional measures to combat subsidence compared to current policy (Deltares, 2017; Erkens et al., 2021).

Figure 6.4 Causes of subsidence



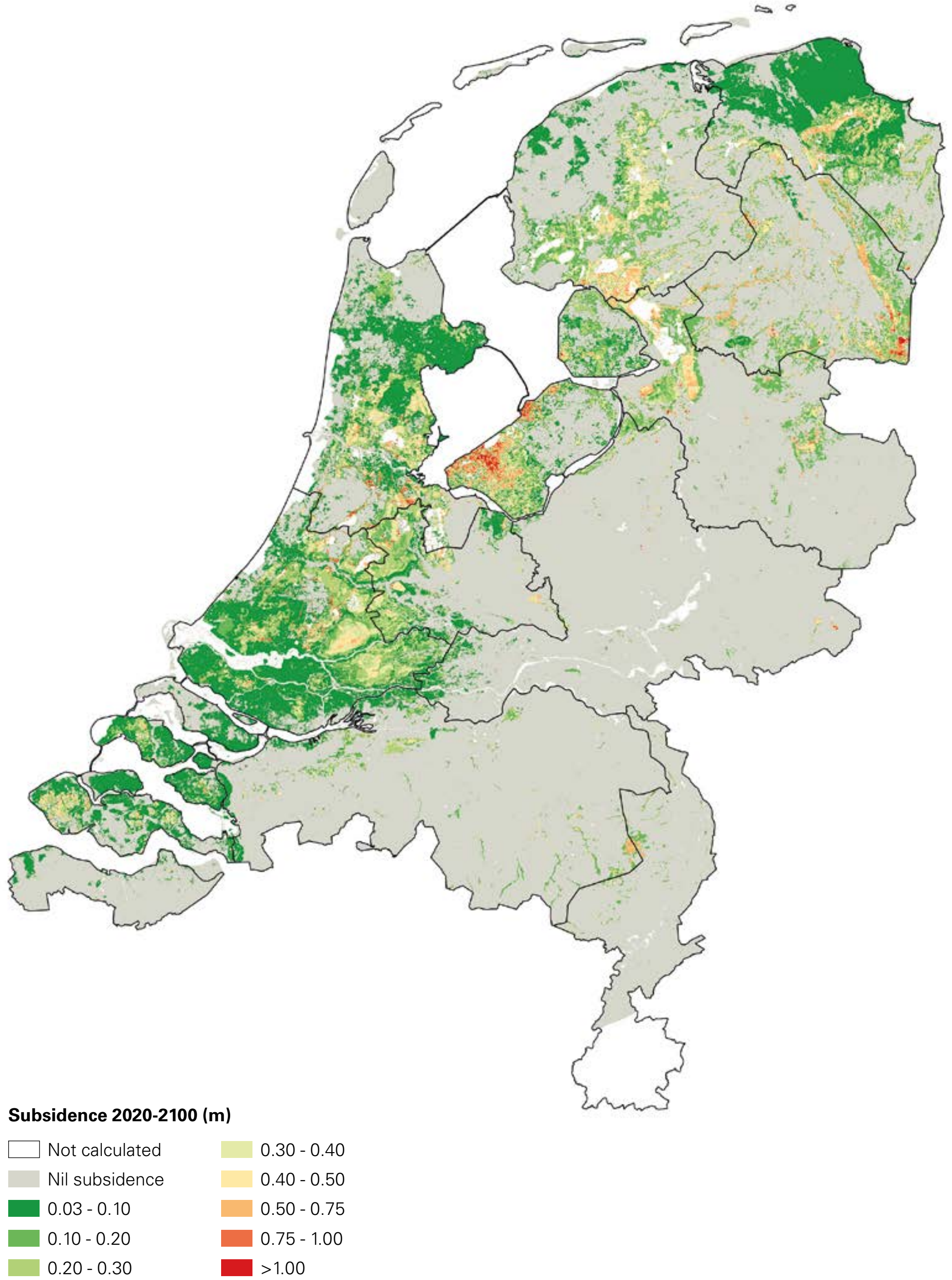
(Deltares, 2017)

Figure 6.5 Scenario of strong subsidence (no additional measures)



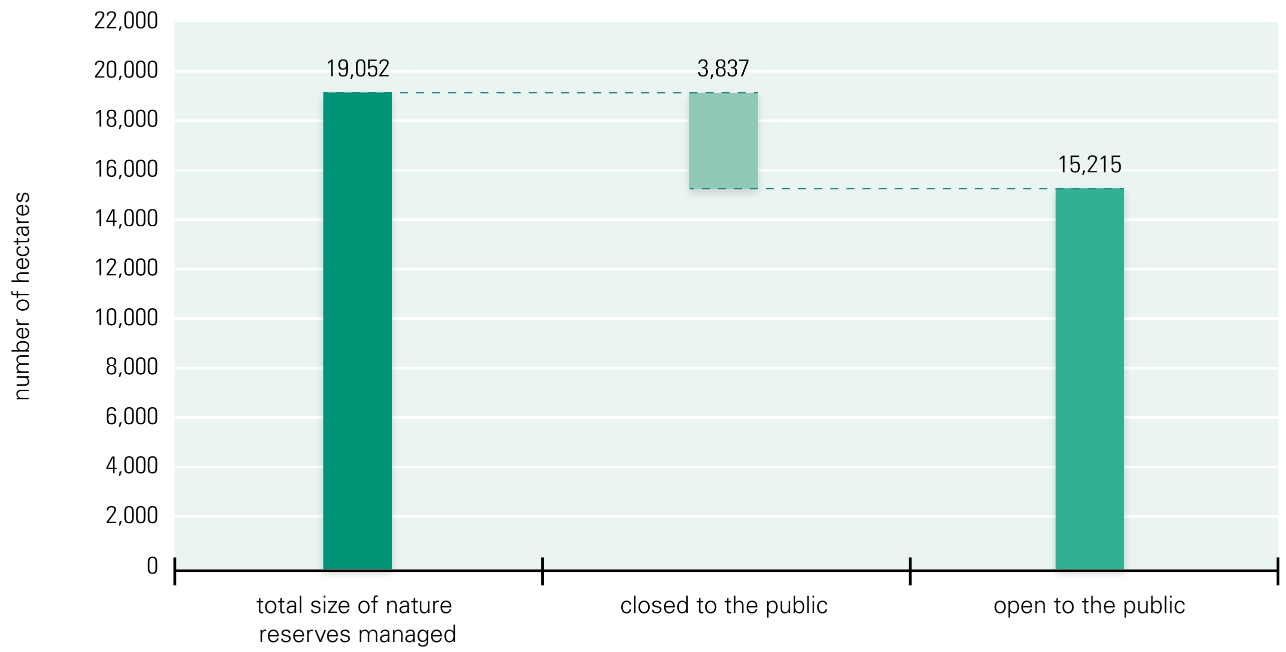
(Erkens et al., 2021)

Figure 6.6 Scenario of mild subsidence (with additional measures)



(Erkens et al., 2021)

Figure 6.7 Nature conservation area managed by drinking water companies, 2020



6.2 Nature and drinking water

6.2.1 Nature conservation areas

After National Forest Service in the Netherlands (Staatsbosbeheer), the Society for the Preservation of Nature in the Netherlands (Vereniging Natuurmonumenten) and the Ministry of Defence, the drinking water sector is the largest nature management organisation in the Netherlands (Alterra, 2016).

The drinking water companies manage an area of 21,580 ha for water extraction. This is largely made up of nature conservation areas: a total of 19,052 ha. This corresponds to 0.5% of the total surface area of the Netherlands. Not only are the managed nature conservation areas used to extract water, they are for the most part (80%) also open to the public (see figure 6.7).

Biodiversity is very high in areas owned or managed by drinking water companies. About 75-95% of all Dutch plants and animals are represented in these areas, including a large share of endangered species (see Table 6.1).

6.2.2 Nature Network Netherlands and Natura 2000 areas

The drinking water sector makes a significant contribution to the quantity and quality of Natura 2000 areas and the Nature Network Netherlands (NNN) (Alterra, 2016).

Nature Network Netherlands (NNN)

The NNN, which was introduced in 1990 as the National Ecological Network (NEN), is a network of existing and future areas within the Netherlands. The aim of NNN is to create a continuous network of (nature conservation) areas in order to prevent the decline in areas of nature and biodiversity (Statistics Netherlands, PBL & WUR, 2020b). Ultimately, the NNN, together with nature conservation areas in the rest of Europe, is to form the Pan-European Ecological Network (PEEN) (Dutch Government, 2021).

Table 6.1 Biodiversity in areas owned or managed by drinking water companies

	Number of sigh-tings	Total number of species found	Percenta-ge of all species	Number of endange-red species found	Percentage of all en-dangered species	National total for number of species	National total for number of endange-red species
Amphibians	10,714	16	89	8	89	18	9
Butterflies	179,746	55	77	24	50	71	48
Lichens	16,767	275	43	59	19	633	315
Dragonflies	39,830	54	90	12	52	60	23
Mosses	29,917	253	41	55	27	623	202
Moths	83,475	1,264	58	na	na	2,170	na
Reptiles	8,855	6	86	5	83	7	6
Fungi (mushrooms)	29,323	997	28	278	17	3,500	1,648
Grasshoppers and crickets	14,978	34	76	8	57	45	14
Vascular plants	285,271	1,286	86	226	43	1,500	530
Fish	3,220	34	28	9	21	123	42
Birds	250,809	257	95	69	88	270	78
Molluscs	1,531	92	55	15	22	166	68
Mammals	44,450	53	75	12	48	71	25

(Alterra, 2016)

In addition to existing and future nature conservation areas, the NNN consists of large bodies of water (such as Lake IJssel and the Wadden Sea) and agricultural land. Figure 6.8 shows the Nature Network on land. The size measures approximately 695,000 ha (LNV & IPO, 2019).

There are many places of overlap between the groundwater protection areas and NNN areas. Research by Alterra (2016) shows that 77.1% of the areas owned or managed by drinking water companies are part of NNN.

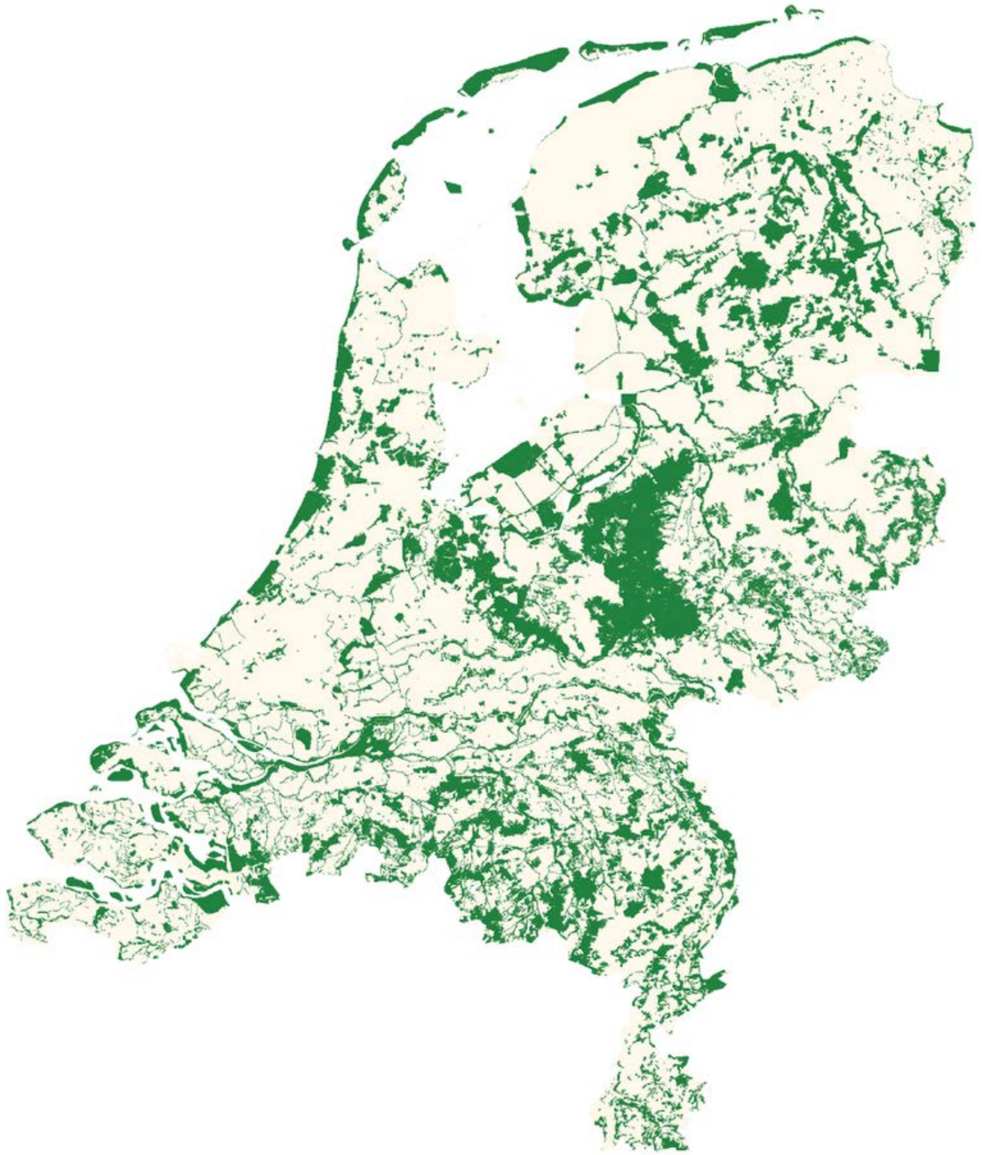
Natura 2000

Natura 2000 is a network of nature conservation areas in the European Union (EU), which are protected under the European Birds Directive and the Habitats Directive. The aim of Natura 2000 is sustainable protection of flora and fauna (Natura 2000 steering group, 2021).

The Netherlands is home to more than two million hectares of Natura 2000 areas, of which 570,000 hectares on land and inland waterways. The Natura 2000 areas are largely within the NNN and as such enjoy planning protection. About 22,000 ha falls outside the NNN area. These areas are covered by a narrower protection regime than the Natura 2000 areas within the NNN (Statistics Netherlands, PBL & WUR, 2020b). Figure 6.9 provides an overview of the Natura 2000 areas in the Netherlands in 2018.

Figure 6.10 provides an overview of the Natura 2000 areas and the groundwater protection areas. Research by Alterra (2016) shows that 63.9% of the areas owned or managed by drinking water companies are under Nature 2000 protection. In addition, there are a large number of sites where groundwater protection areas are close to Natura 2000 areas.

Figure 6.8 Nature Network Netherlands, 2019



The land-based sections of the Nature Network Netherlands

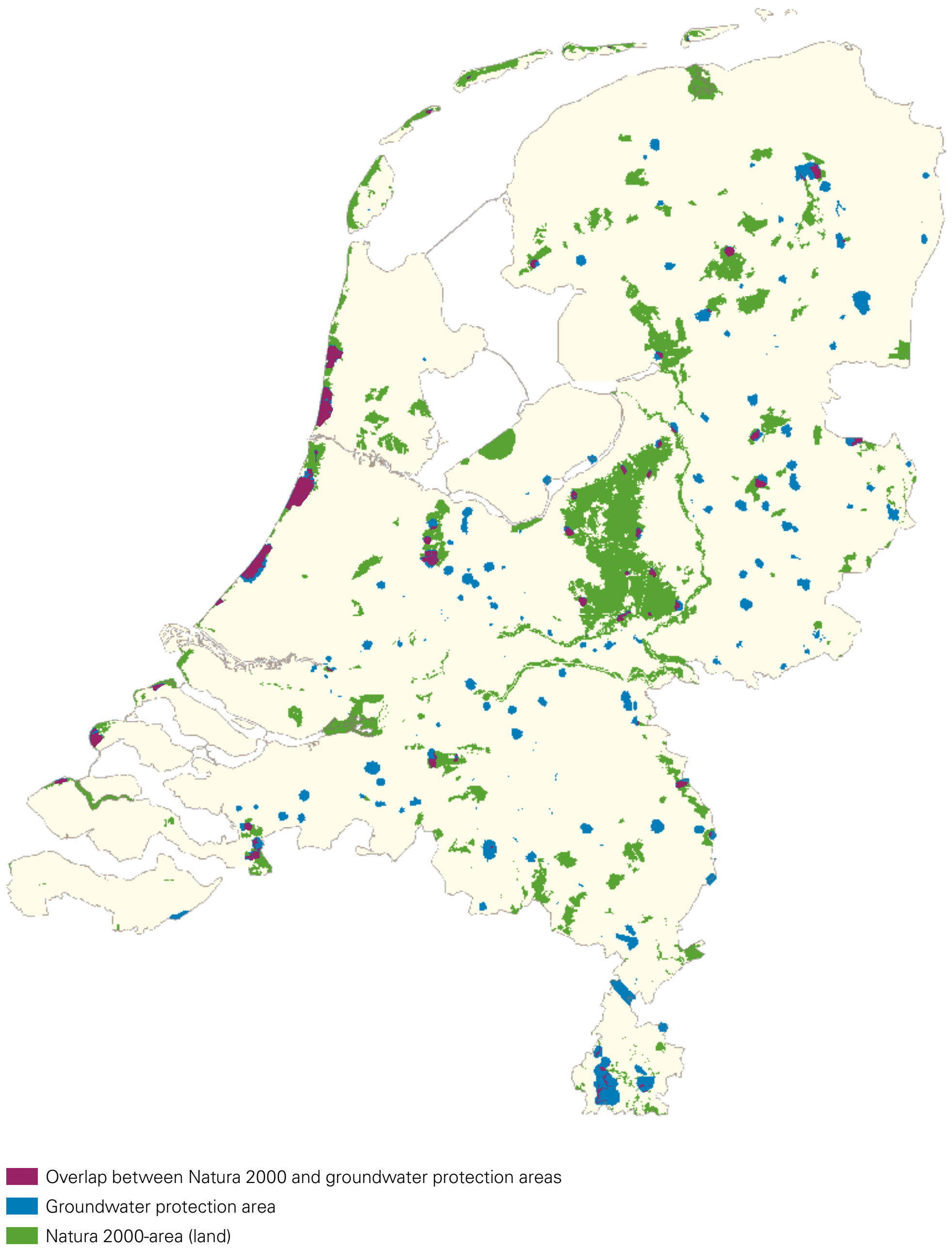
(Statistics Netherlands, PBL & WUR, 2020b)

Figure 6.9 Natura 2000 areas in the Netherlands, 2018

Area governed by the Birds Directive and the Habitat Directive
Area governed by the Habitat Directive
Area governed by the Birds Directive

(Statistics Netherlands, PBL & WUR, 2020b)

Figure 6.10 Natura 2000 and groundwater protection areas



(KWR, 2021)

6.3 Mining and drinking water

A total of 66% of Dutch drinking water is produced from groundwater, riverbank filtration water and natural dune water. The soil provides natural purification and impermeable soil layers ensure good protection of the groundwater supply.

The subsoil is also important in terms of the energy supply. For example, natural gas and oil are extracted from the subsoil and geothermal energy and ground energy are becoming increasingly important. The subsoil is also used as storage of, for example, CO_2. In order to prevent conflicts between uses in the longer term, the Subsoil Structural Vision (STRONG) has been drawn up (see § 2.1.5). The starting point for the protection of groundwater protection areas is the separation of functions between drinking water and mining. In principle, this also applies to the ASVs, yet the interpretation may differ per province. In STRONG it is stated that the Dutch government will formulate the protection policy for the NGRs. Figure 2.7 previously provided insight into the areas for NGRs and (potential) ASV areas. Figure 6.11 additionally shows the groundwater protection areas on the map, creating an overall picture of all drinking water areas subject to a (potential) protection policy.

6.3.1 Natural gas extraction and storage in empty gas fields

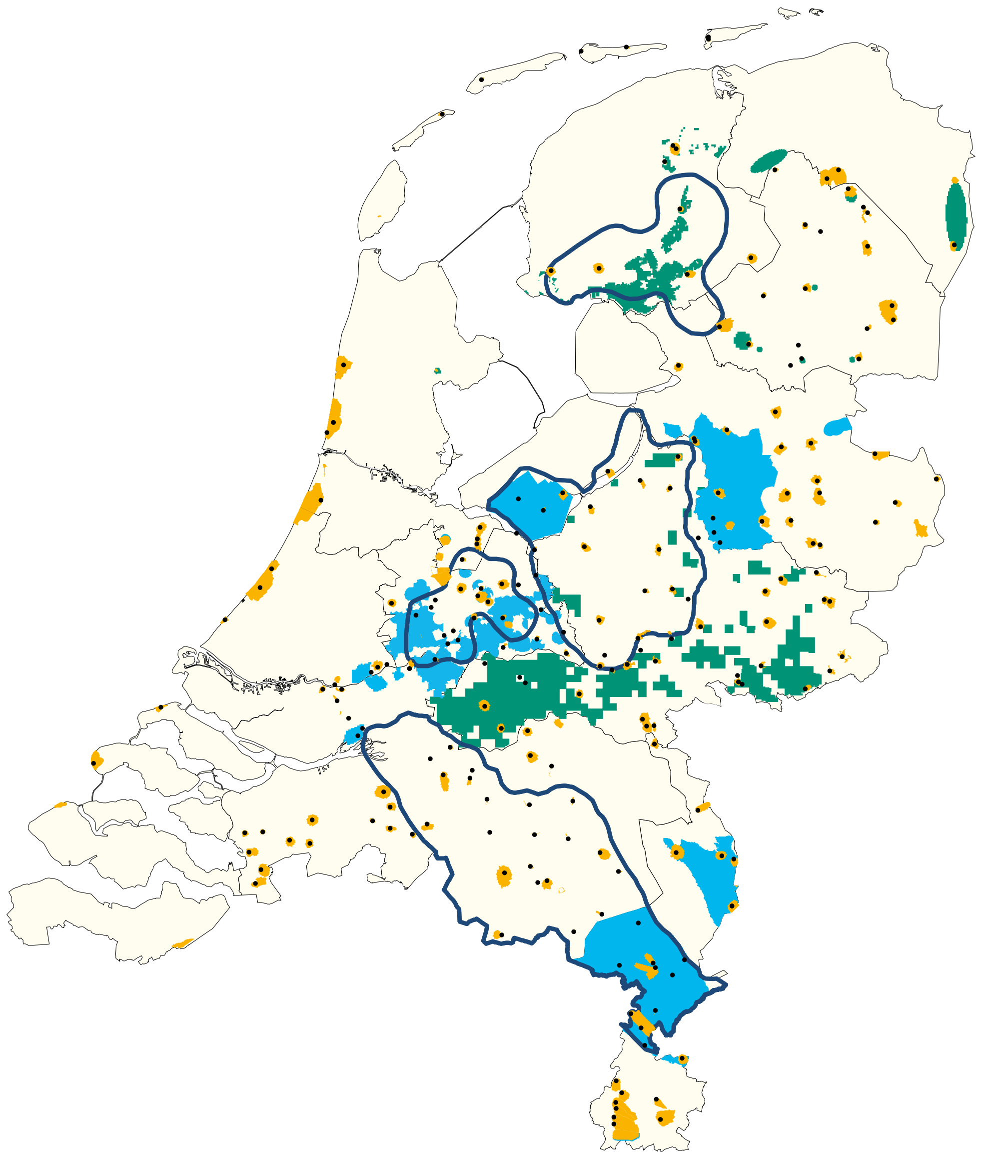
Natural gas is the most commonly used fuel in the Netherlands. It provides approximately 44.5% of the primary energy requirement (Statistics Netherlands, 2021a; IenW & EZK, 2018) and is extracted at a depth of a few kilometres.

Figure 6.12 provides an overview of the potential area for gas extraction in relation to the areas that are important to the drinking water supply. It paints a national picture of the gas fields that are currently being exploited, well-known small fields with potential for gas extraction and areas where gas may still be found in the future. In addition, the current protected areas (i.e. excluding potential ASVs) for drinking water extraction are shown on the map.

Empty gas fields can be used for various purposes. For example, empty and depleted gas fields are suitable for storing natural gas. In addition, empty gas fields can be used for CO_2 storage.

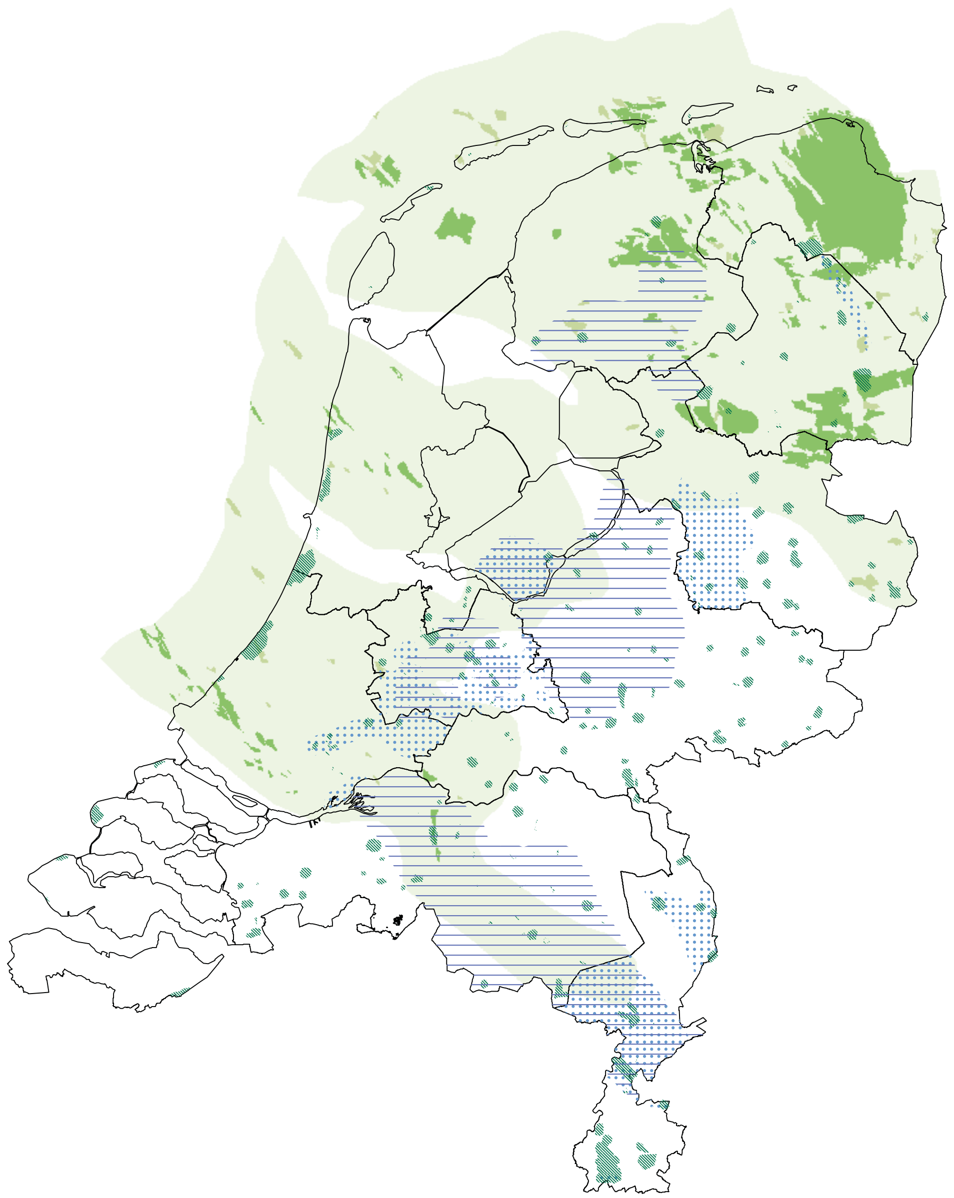
Figure 6.13 shows, among other things, where empty gas fields are located and where industry with significant CO_2 emissions is located. Where industry is located close to empty gas fields, there may be opportunities for CO_2 storage. The figure also shows which gas fields are currently used for natural gas buffering. There are four gas fields in the Netherlands that are used for natural gas buffering: at Norg, Grijpskerk, Bergermeer and Alkmaar (IenW & EZK, 2018).

Figure 6.11 National Groundwater Reserves, Additional Strategic Resources and groundwater protection areas



- Extraction site
- Groundwater protection area
- National groundwater reserves
- Additional strategic groundwater resources
- Potential additional strategic groundwater resources

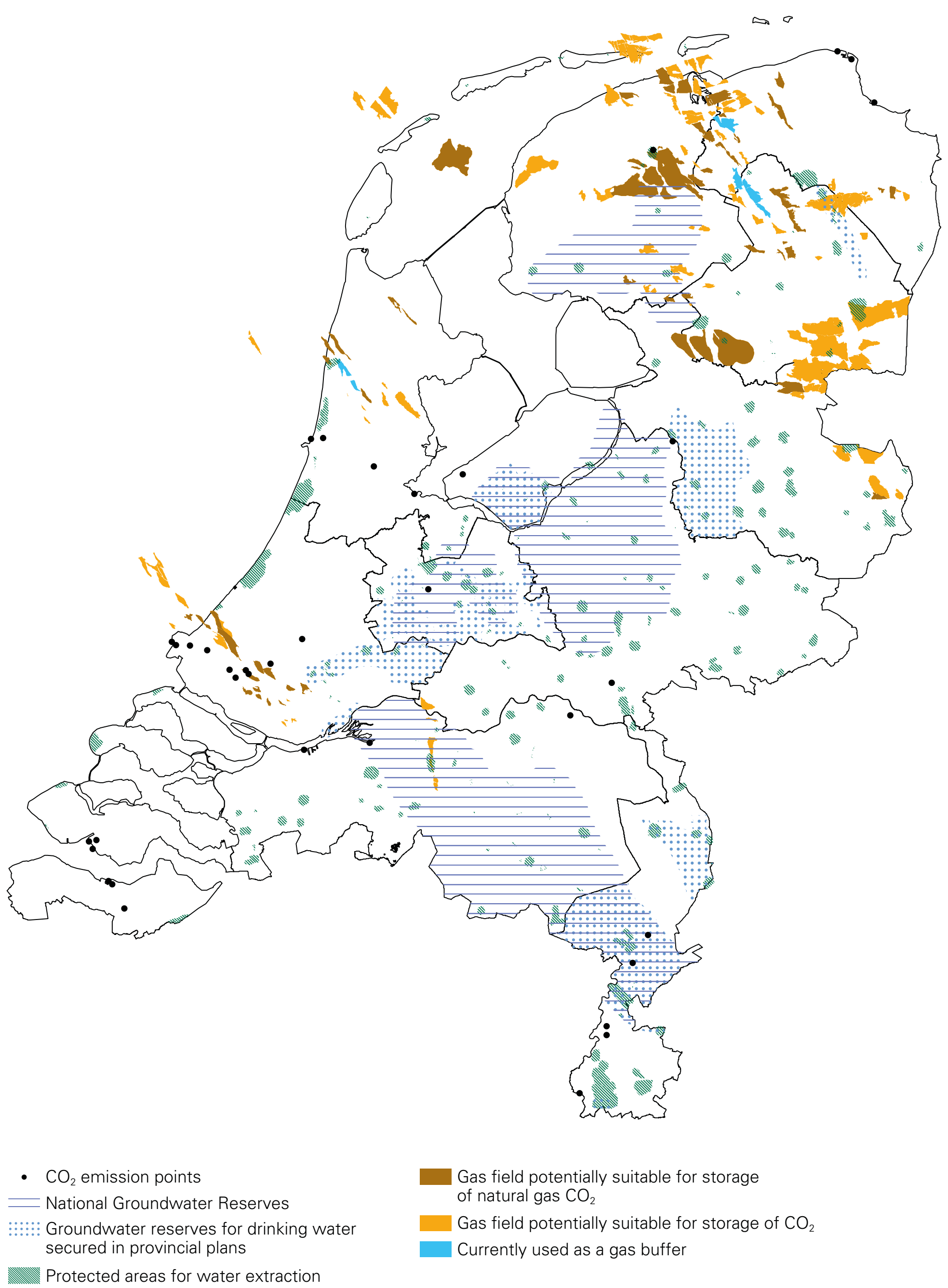
Figure 6.12 Potential areas for conventional gas extraction in relation to areas for drinking water



- National Groundwater Reserves
- Protected areas for water extraction
- Groundwater reserves for drinking water secured in provincial plans
- Gas fields identified (no decision regarding extraction made as yet)
- Gas fields currently in use
- Potential gas extraction sites

(IenW & EZK, 2018)

Figure 6.13 Gas fields possibly suitable for storage of natural gas and CO_2 in relation to areas for drinking water



(IenW & EZK, 2018)

6.3.2 Petroleum

Of the total energy consumption in the Netherlands, about 37% is accounted for by petroleum (Statistics Netherlands, 2021a). The Netherlands produces approximately 9% of its own needs, mainly from the North Sea. The rest is imported (Statistics Netherlands, 2021a).

Figure 6.14 provides an overview of the oil fields in the Netherlands and the areas that are important to the drinking water supply. Petroleum is found in the North Sea and in the provinces of Drenthe and South Holland, among other places.

6.3.3 Geothermal energy

Geothermal energy, also called terrestrial heat, is the energy that can be extracted from heat reservoirs in the (deep) subsoil (IenW & EZK, 2018). The number of operational geothermal systems has grown from 17 in 2018 to 24 in 2020. Consequently, development is slower than expected. (SODM, 2021)

Figure 6.15 provides an overview of the potential areas for geothermal energy and the areas that are important to the drinking water supply. The figure shows that many areas that are promising for geothermal energy overlap with areas that are important to the drinking water supply.

Geothermal energy is not permitted in the water extraction areas, groundwater protection areas and drilling-free zones around existing groundwater extraction sites for the drinking water supply. Separation of functions is also the starting point for additional strategic resources, but this may differ per province.

6.3.4 Shale gas

Shale gas is a fossil energy source that is locked up in shale layers: petrified clay layers in the deep subsoil. To date, no shale gas has been extracted for commercial purposes in the Netherlands and after an exploration in the draft Subsoil Structural Vision, the Minister of Economic Affairs and Climate indicated in 2018 that in the current Subsoil Structural Vision, the exploration and extraction of shale gas is excluded (IenW & EZK, 2018).

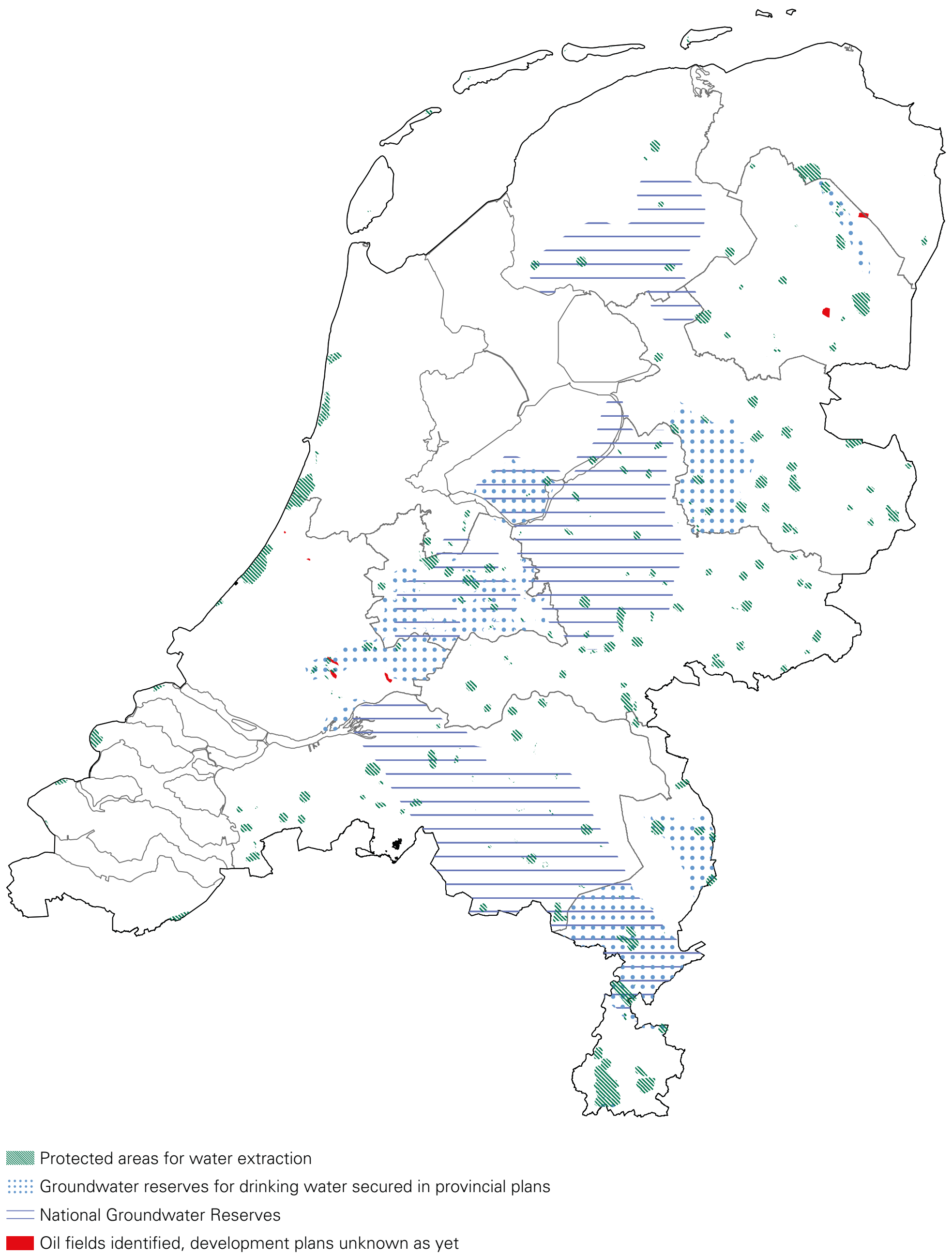
6.3.5 Salt extraction and storage in salt caverns

In the Netherlands, rock salt is extracted in the province of Twente, Groningen and Friesland. Figure 6.16 provides a spatial overview of the potential areas for salt extraction and the areas that are important to the drinking water supply.

Salt extraction creates cavities, or salt caverns, which can be used for the storage of substances for the purpose of energy supply (such as natural gas, compressed air and hydrogen).

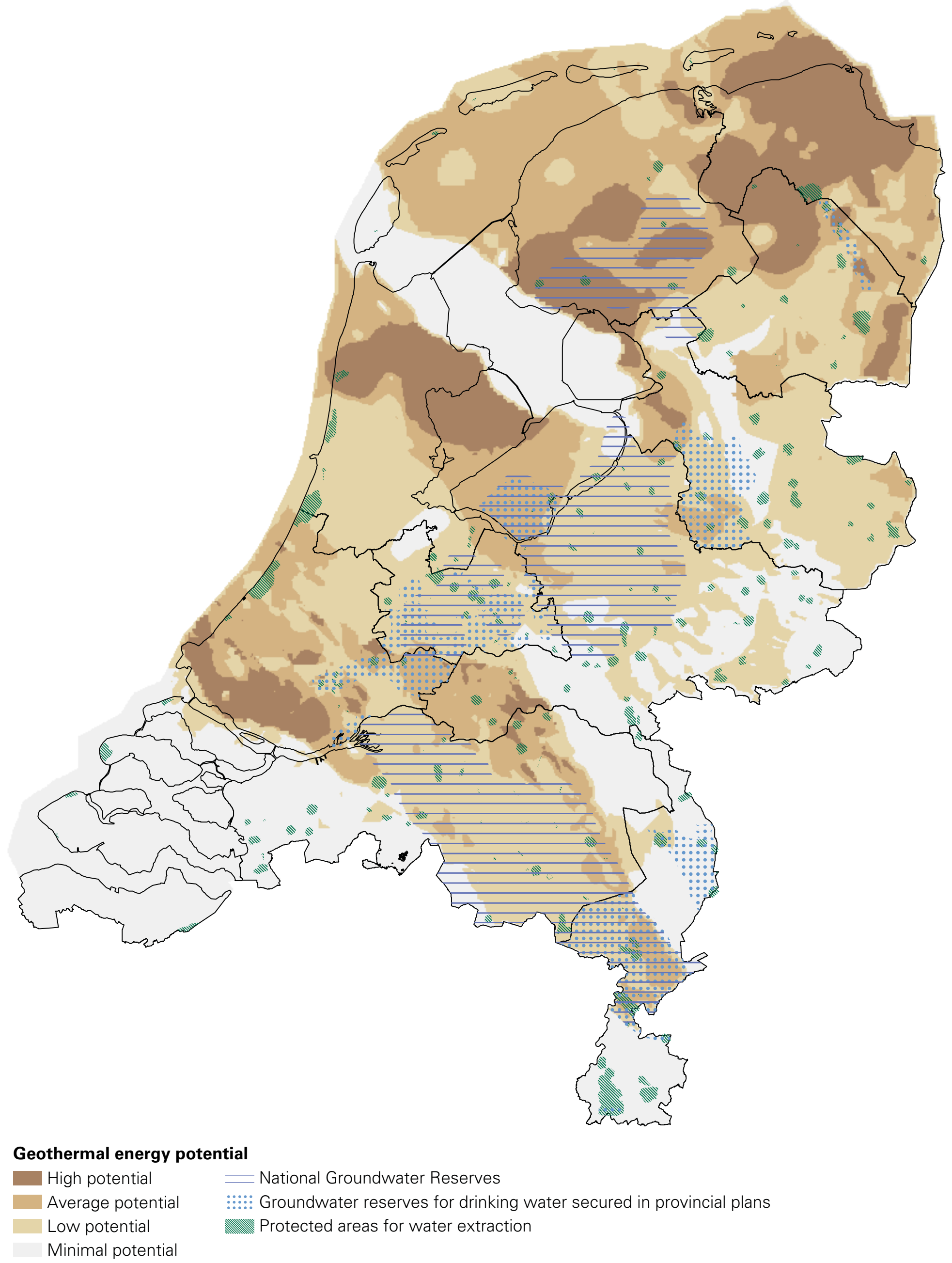
Figure 6.17 shows which salt caverns are already being used for storage and shows the potential area for the formation of salt caverns. High caverns have a minimum height of 300 metres, to a depth of 1500 metres (Tauw, 2016).

Figure 6.14 Potential areas for oil extraction in relation to areas for drinking water



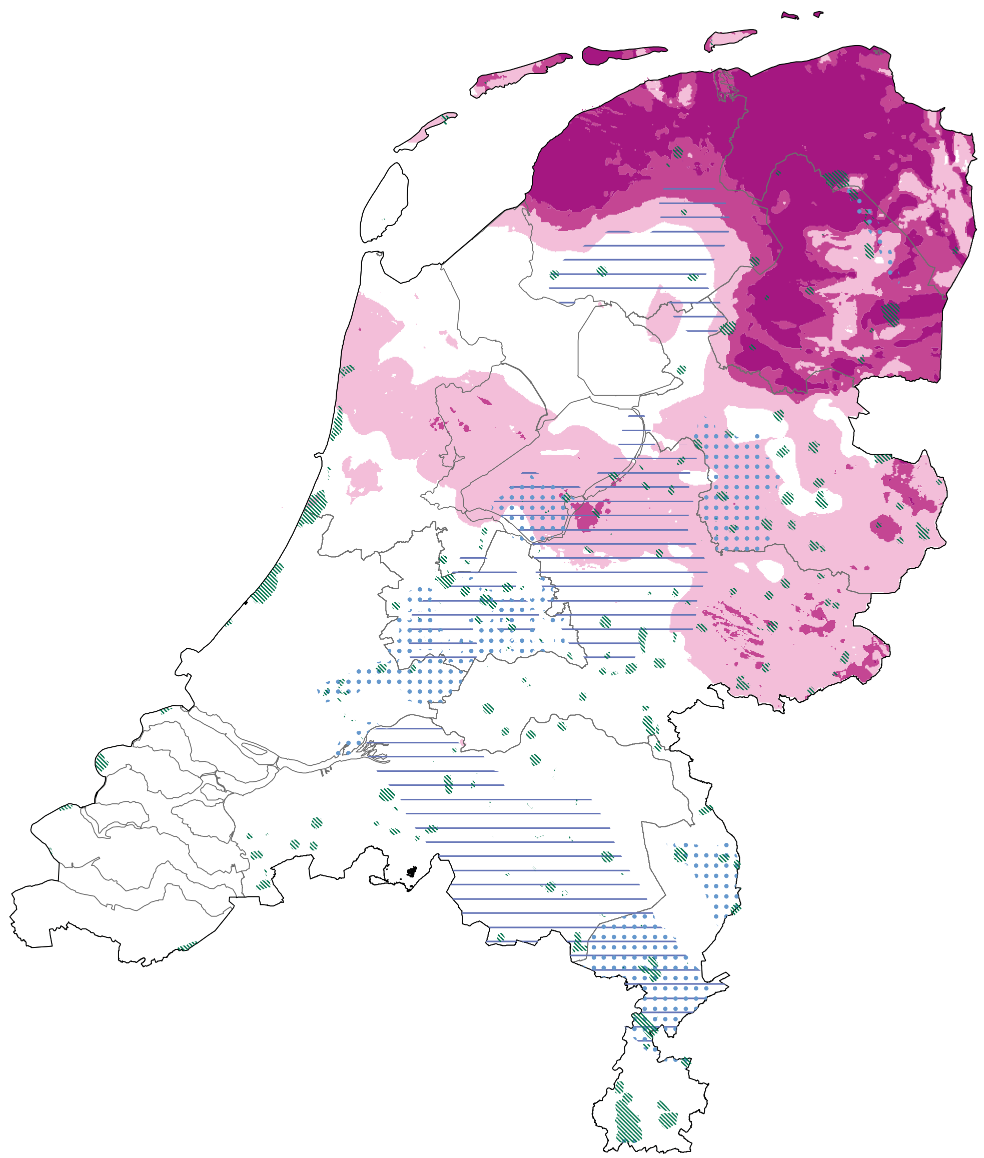
(IenW & EZK, 2018)

Figure 6.15 Potential areas for geothermal energy in relation to areas for drinking water



(IenW & EZK, 2018)

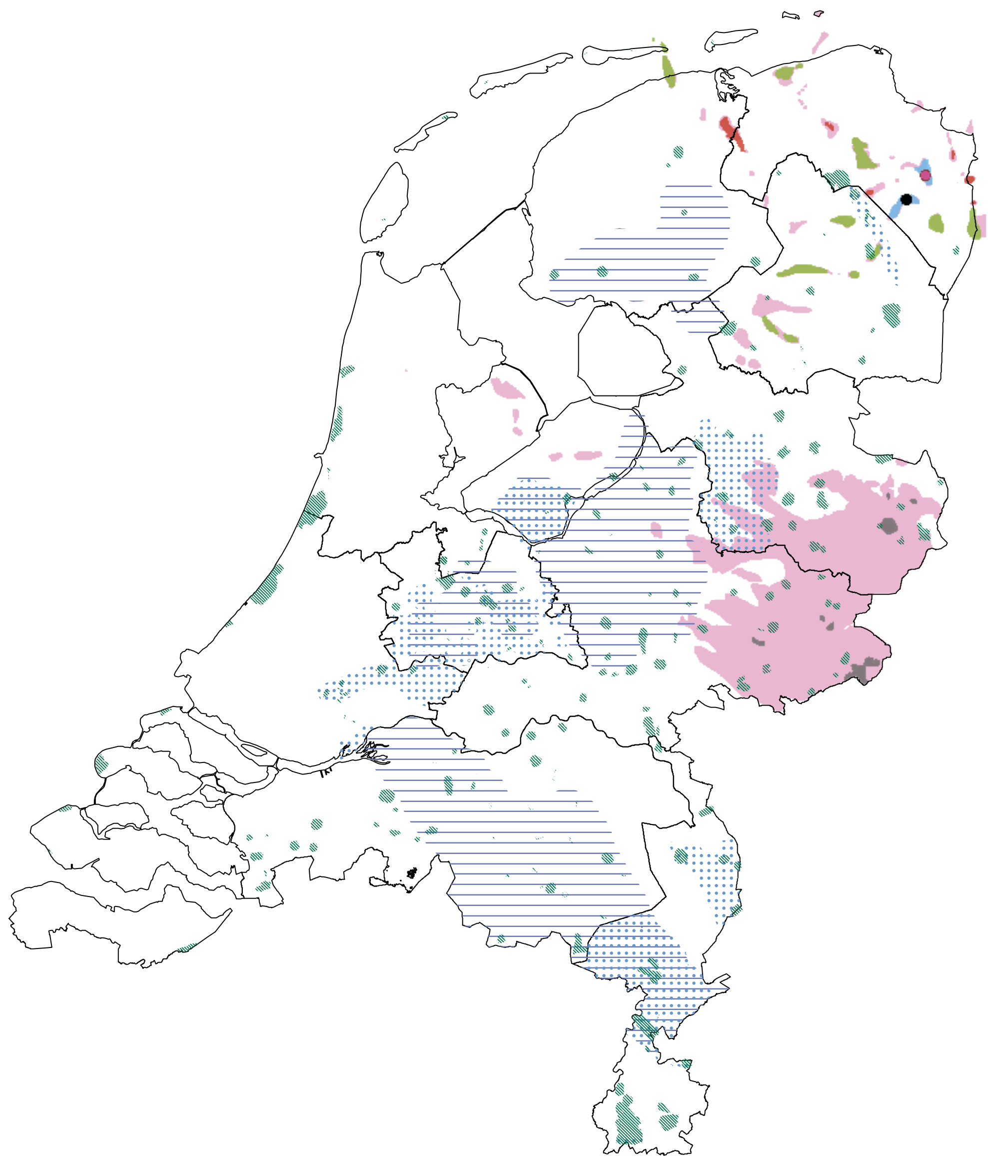
Figure 6.16 Potential areas for salt extraction in relation to areas for drinking water



Protected areas for water extraction
Groundwater reserves for drinking water secured in provincial plans
National Groundwater Reserves
Low potential for salt mining
Average potential for salt mining
High potential for salt mining

(IenW & EZK, 2018)

Figure 6.17 Potential areas and existing use of storage in salt caverns in relation to areas for drinking water



Potential for low caverns
Potentially suitable

Potential for high caverns
Potentially suitable
Probably unsuitable
Suitability unknown

In use for storage
In use as a gas buffer
Nitrogen buffer
Natural gas buffer

Protected area for water abstraction
Groundwater reserves secured for drinking water in provincial plans
National Groundwater Reserves

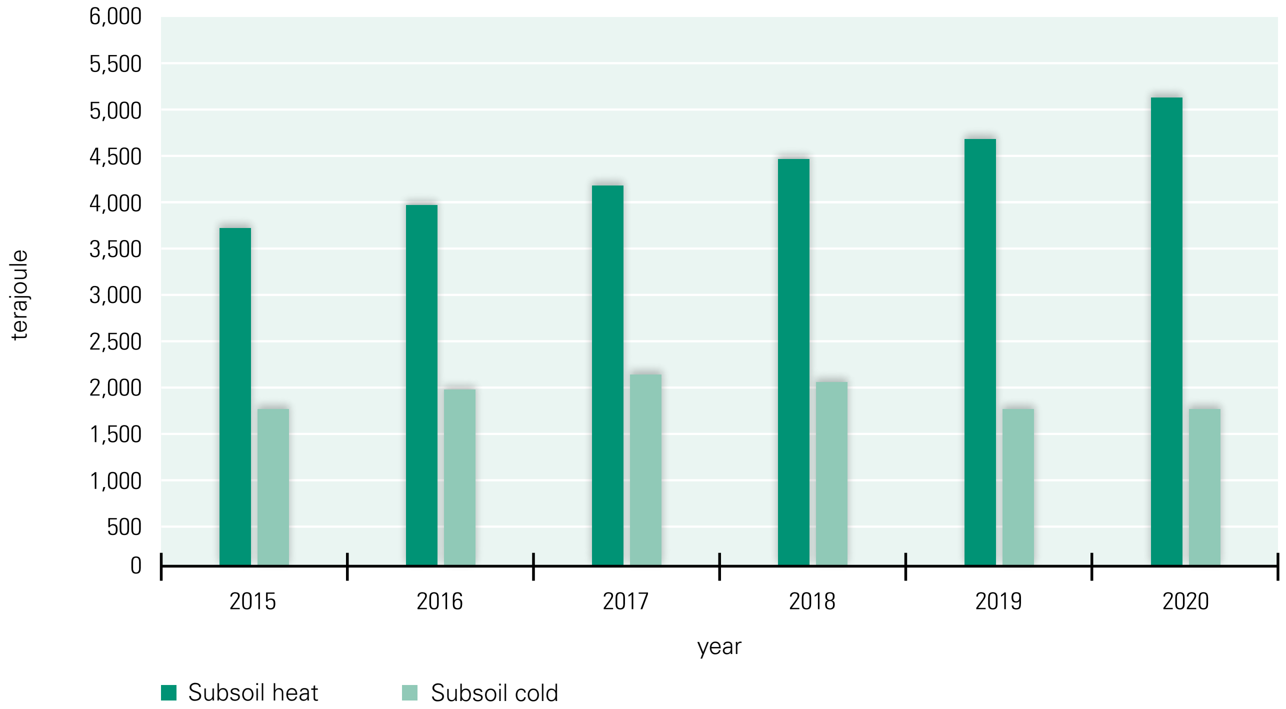
(IenW & EZK, 2018)

6.4 Ground energy

Ground energy concerns the use of aquifers for the storage and abstraction of heat or cold in the shallow subsoil, to a depth of 500 metres. This can be in open systems (heat/cold storage) or by means of a closed pipe system (ground heat exchanger).

Figure 6.18 shows the development of ground energy use between 2015 and 2020. The Netherlands is making increasing use of ground energy. The use of ground energy has increased by 38% between 2015 and 2020.

Figure 6.18 Ground energy use between 2015 and 2020

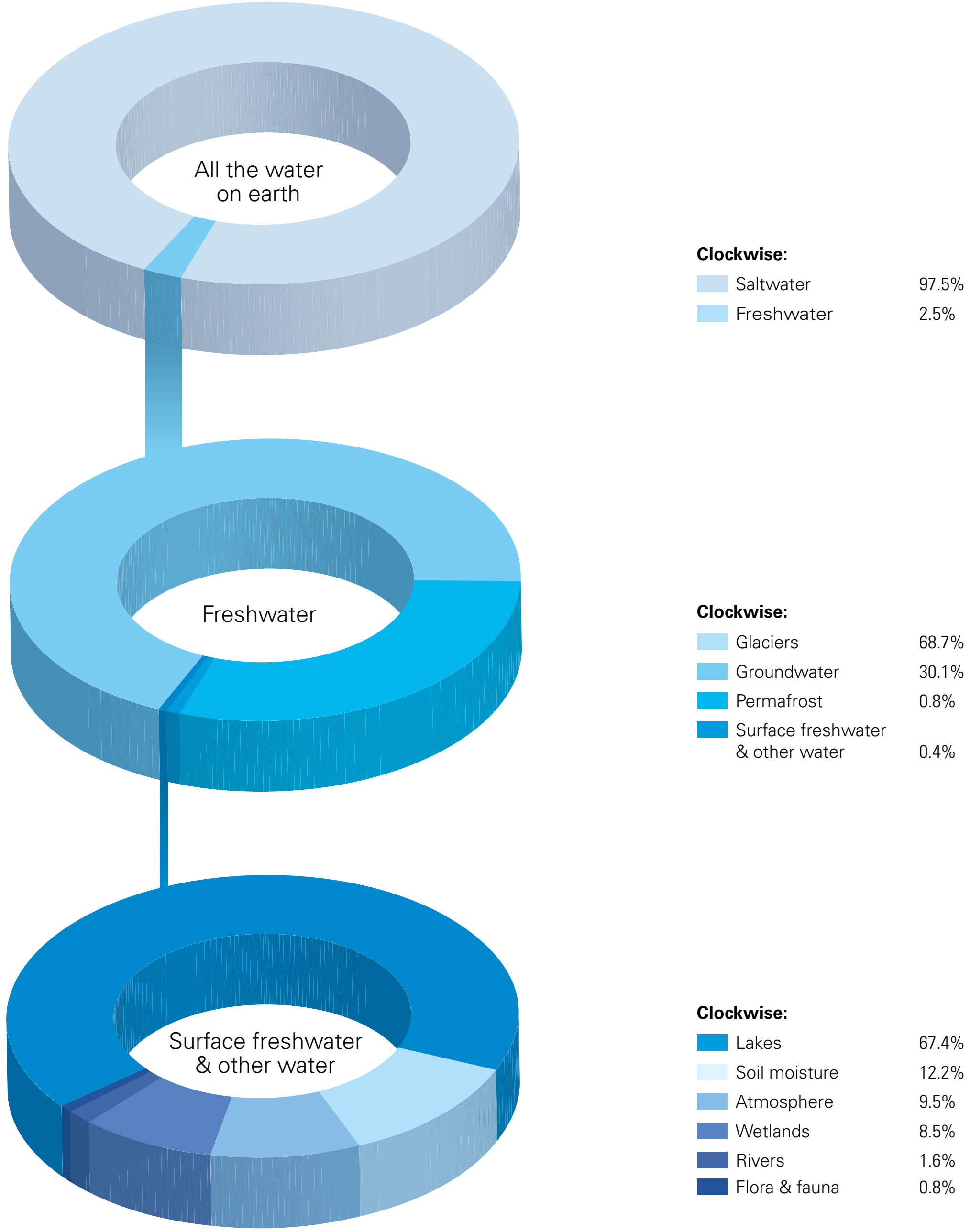


(Statistics Netherlands, 2021)

7 International

In this chapter, the Dutch drinking water sector is placed in an international perspective. § 7.1 provides information about the worldwide availability of freshwater sources and the use thereof. This paragraph also provides insight into what extent people on the various continents have access to safe drinking water. In § 7.2, we then compare a number of indicators of the drinking water sector at European level, such as drinking water use and to what extent the population is connected to the drinking water network.

Figure 7.1 Global distribution of the water on Earth



(VN, 2006)

7.1 Water availability and usage

7.1.1 Global

Figure 7.1 shows the global distribution of water at the beginning of this century (UN, 2006). The vast majority of water on Earth is salt (97.5%). More than two-thirds of the fresh water (2.5%) is stored in the ice caps, almost a third is groundwater and less than one percent (0.4%) is in freshwater lakes and rivers. Climate change is expected to strongly decrease the volume of the ice caps (particularly in the Arctic) and permafrost, combined with a simultaneous rise in sea levels (IPCC, 2021).

Table 7.1 shows an overview of renewable freshwater resources per continent and their abstraction, broken down by sector. Renewable freshwater is water that becomes available in annual cycles through the river supply and the precipitation surplus. The percentage that is abstracted from renewable resources in a country is called the Water Exploitation Index (WEI). In Europe, the WEI is 3.8% on average. In the Netherlands, approximately 92 km^3 (= 92 billion m^3) of renewable freshwater becomes available each year. In the very hot and dry year of 2018, a total of 79.5 km^3 became available (§ 2.2.1). If we compare this latter volume with the freshwater abstraction in the Netherlands in 2019 (8.4 km^3, see table 2.2), the WEI is 10.6%.

Table 7.1 Freshwater resources and abstractions, by continent [1)]

Continent	Renewable freshwater resources		Total freshwater abstraction	Total water abstraction [2)]	Agricultural water abstraction	Industrial water abstraction	Household water abstraction	Water Exploitation Index [3)]
	km^3/year	*%*	*km^3/year*	*km^3/year*	*km^3/year*	*km^3/year*	*km^3/year*	*%*
North America	6,433	11.8	568	568	246	245	78	8.8%
Central America and the Caribbean	777	1.4	32	33	22	4	7	4.2%
South America	17,957	32.8	211	211	150	24	38	1.2%
Africa	5,630	10.3	222	236	186	16	34	3.9%
Asia	15,242	27.8	2,529	2,641	2,168	228	245	16.6%
Europe	7,789	14.2	292	298	90	140	69	3.8%
Oceania	902	1.6	26	22	14	4	4	2.9%
World	54,730	100	3,880	4,009	2,875	660	474	7.1%

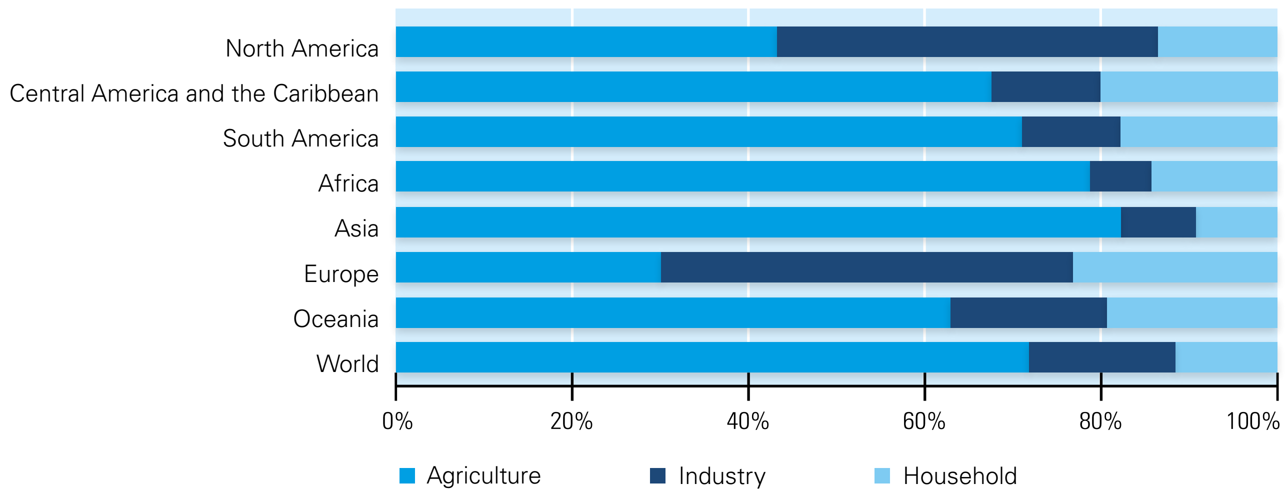
1) The data year differs from country to country; for most countries / continents, it is 2017.

2) Includes use of desalinated water, direct use of treated municipal wastewater and direct use of agricultural drainage water.

3) Total freshwater abstraction as a percentage of renewable freshwater resources.

(FAO, 2017)

Figure 7.2 Water abstraction by sector, by continent, around 2017



(FAO, 2017)

Globally, the agricultural sector is the largest consumer of water, accounting for 72% of water abstraction (Figure 7.2). This is followed by water abstraction by industry (16%) and, lastly, by domestic water abstraction (including drinking water production) (12%).

Total freshwater abstraction in Europe amounts to approximately 292 km^3 per year. In Europe, industry is the largest consumer of water at 47%, followed by agriculture at 30%. For the Netherlands, the figures are specified in §2.1.1.

7.1.2 Europe

Table 7.2 shows long-term averages of the freshwater resources of the 27 EU Member States. The bottom of the table also shows this information for several non-EU countries. Eurostat has asked the countries for the average for the years 1981-2010, but indicates that periods can sometimes differ.

The freshwater resources per inhabitant, per EU Member State, are shown in figure 7.3. If the freshwater per capita is lower than 1,700 m^3 per inhabitant, it is referred to as water stress (UNWWAP, 2015). According to this UN definition, Poland (1,600 m^3 per inhabitant), Czech Republic (1,519 m^3 per inhabitant), Cyprus (358 m^3 per inhabitant) and Malta (164 m^3 per inhabitant) are experiencing water stress.

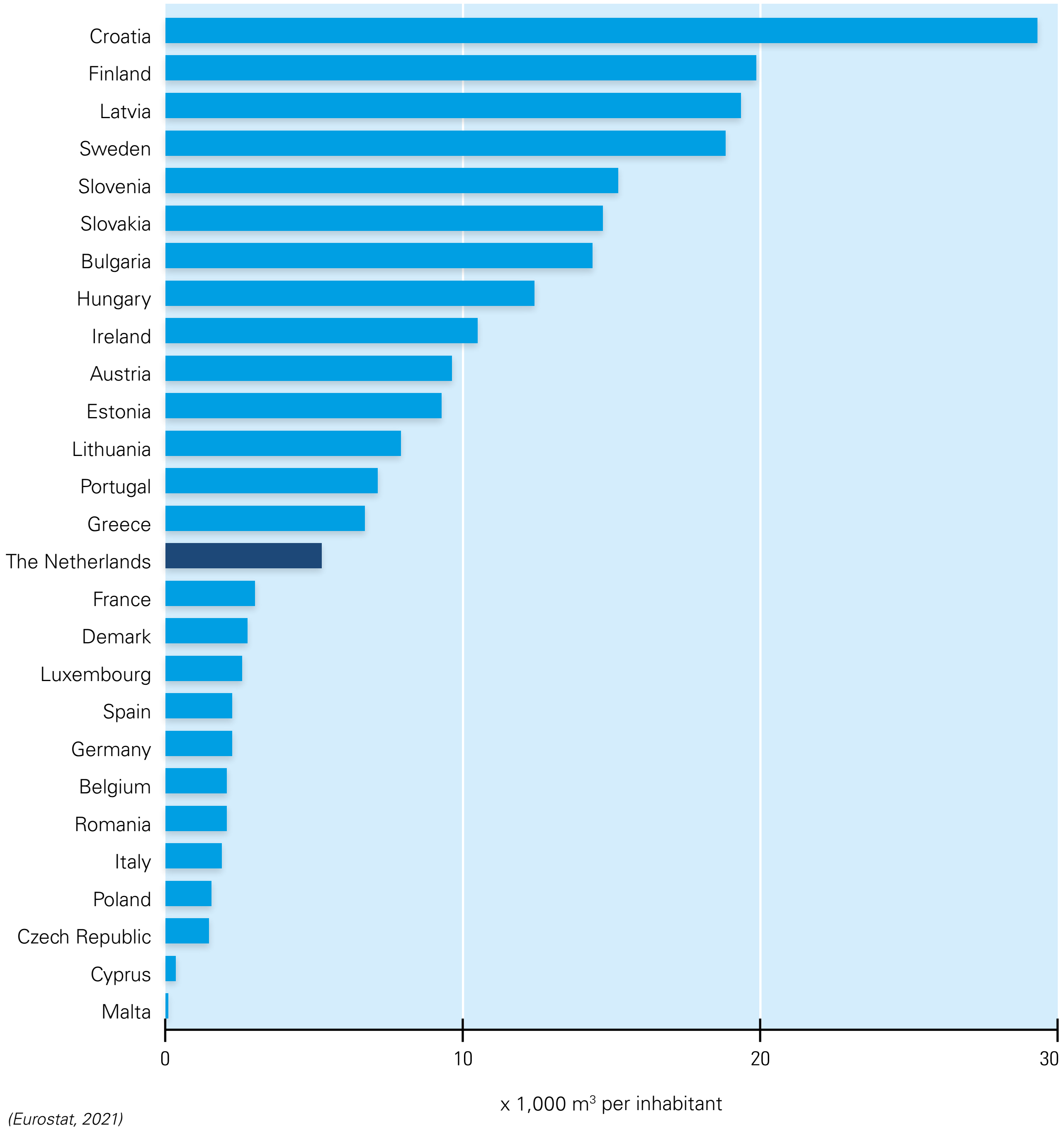
Table 7.2 Freshwater resources - the long-term annual average (billion m^3) [1)]

	A. Precipitation	B. Evapotranspiration	C. Precipitation surplus (C = A–B)	D. External inflow	E. Renewable freshwater resources (E = C+D)	F. Outflow
Belgium	28.0	15.8	12.3	11.6	24.0	25.7
Bulgaria	73.3	57.3	16.1	83.7	99.8	102.2
Cyprus	3.0	2.7	0.3	0.0	0.3	0.1
Denmark	38.5	22.1	16.3	0.0	16.3	1.9
Germany	278.0	161.0	117.0	71.0	188.0	177.0
Estonia	29.0	.	12.3	.	12.3	.
Finland	222.0	115.0	107.0	3.2	110.0	110.0
France	512.6	317.3	195.2	11.0	206.2	168.0
Greece	115.0	55.0	60.0	12.0	72.0	.
Hungary	55.7	48.2	7.5	108.9	116.4	115.7
Ireland	87.6	38.3	49.3	3.5	52.8	.
Italy	281.8	147.3	134.5	30.5	115.8	115.9
Croatia	66.6	42.1	24.5	93.8	118.3	118.3
Latvia	43.2	23.6	19.6	17.0	36.6	32.9
Lithuania	44.9	31.6	13.9	8.4	22.3	23.3
Luxembourg	2.0	1.1	0.9	0.7	1.6	1.6
Malta	0.2	0.1	0.1	.	0.1	0.1
The Netherlands	31.6	21.3	10.3	81.5	91.8	90.9
Austria	99.8	43.0	55.0	29.0	84.0	84.0
Poland	195.7	142.8	52.9	7.7	60.6	60.6
Portugal	82.2	43.6	38.6	35.0	73.6	34.0
Romania	154.6	115.4	39.2	0.4	39.6	17.2
Slovenia	31.7	13.1	18.6	13.5	32.1	32.3
Slovakia	37.4	24.3	13.1	67.3	80.3	81.7
Spain	333.7	226.5	107.2	.	107.2	107.2
Czech Republic	54.1	38.4	15.7	0.6	16.3	15.5
Sweden	344.6	164.6	180.5	14.9	195.3	195.3
Kosovo	0.8	.	.	.	.	.
Bosnia and Herzegovina	55.9	25.9	29.9	2.0	.	31.9
England	287.6	127.3	161.4	.	172.9	171.0
Serbia	57.0	43.7	13.3	158.3	171.6	171.6
Norway	374.8	141.1	233.8	12.3	246.1	393.1
Turkey	503.1	.	.	.	.	.
United Kingdom	287.6	127.3	161.4	6.5	172.9	171.0
Switzerland	61.2	21.4	39.8	12.6	52.4	53.1

1) For definitions: see § 2.1.1.

(Eurostat, 2021)

Figure 7.3 Freshwater resources per capita – long-term average



(Eurostat, 2021)

7.1.3 Millennium Development Goals and Sustainable Development Goals

In 2000, the United Nations (UN) set itself the target that, by 2015 (compared to 1990 levels), the share of the world population without sustainable access to drinking water and sanitation had to be halved. This was one of the Millennium Development Goals (MDGs).

The target for drinking water was already achieved in 2010. In 2017, a total of 91% of the world population had access to improved sources of drinking water compared to 76% in 1990 (WHO, 2015). However, regional variations and differences exist between rural and urban areas (see Table 7.3).

The Sustainable Development Goals (SDGs) came into effect on 1 January 2016. The SDGs build on the MDGs and set targets for the year 2030. A total of 17 sustainability goals have been set. The goal with regard to drinking water is goal 6: "Ensure access to sustainable management of water and sanitation for all". In addition, society-wide goals have been set for, for example, poverty reduction, equality, biodiversity (life in water and life on land), climate action and renewable energy. Unlike the MDGs, which mainly focused on developing countries, the SDGs apply to all countries, including the Netherlands.

The Dutch drinking water companies implement the SDGs in their own business operations and make their expertise available to promote a reliable drinking water supply in developing countries. The Drinking Water Decree states that the Dutch drinking water companies may use a maximum of 1% of their turnover for this.

7.2 Drinking water in Europe

7.2.1 Connection to the water mains

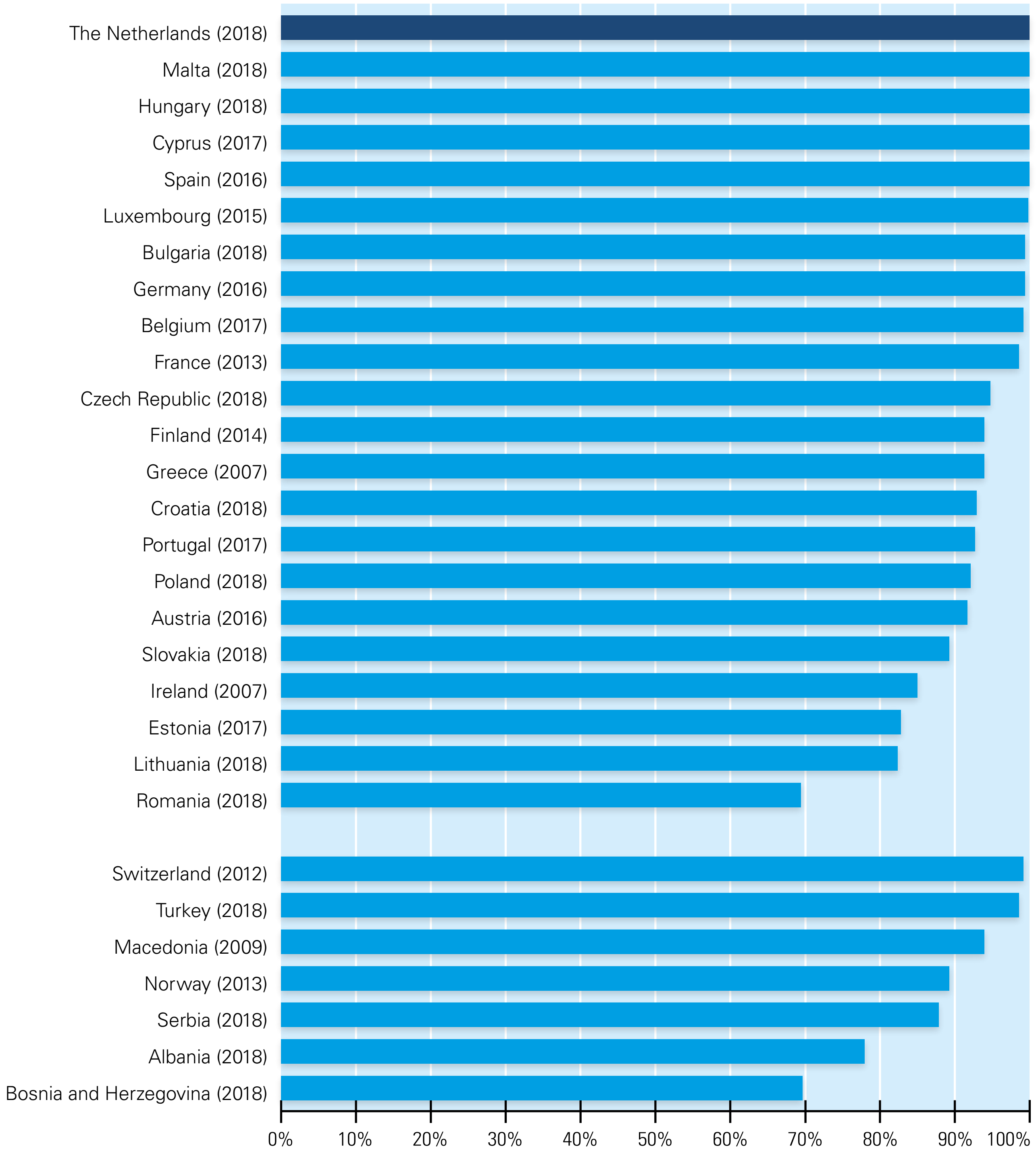
Figure 7.4 shows what percentage of the population is connected to the water mains for 30 of the 51 European countries. EU Member States are shown at the top and non-EU Member States at the bottom. In Europe, 92% of the population is connected to the water mains on average.

Table 7.3 Share of population with access to safe drinking water, 2017 (%)

Continent	Total population with access to safe drinking water	Rural population with access to safe drinking water	Urban population with access to safe drinking water
North America	96	93	98
Central America and Caribbean	93	89	96
South America	95	87	98
Africa	74	65	89
Asia	88	85	94
Europe	99	98	100
Oceania	94	92	97
World	91	87	96

(FAO, 2017)

Figure 7.4 Population connected to the water mains



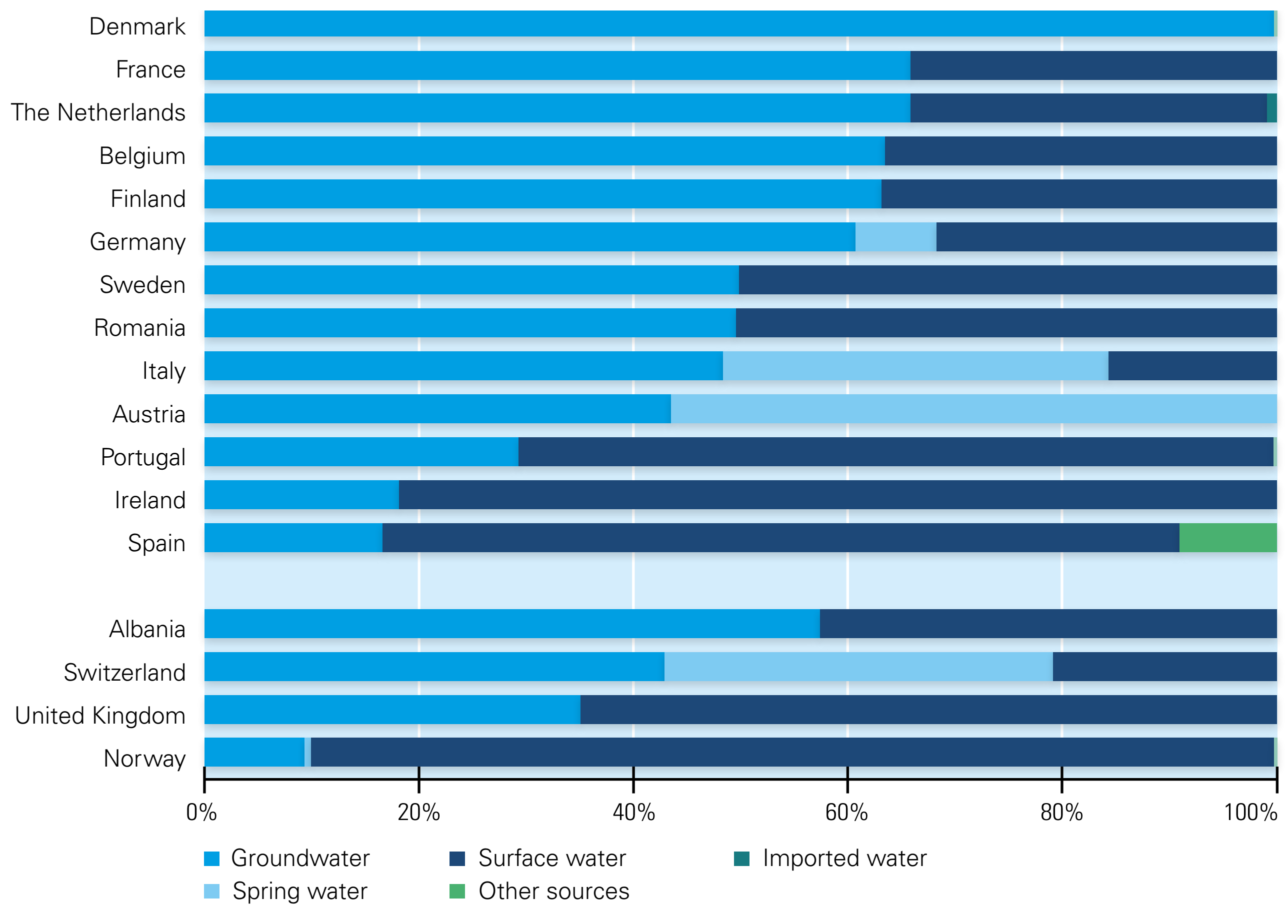
(Eurostat, 2021)

7.2.2 Water extraction for drinking water production

Figure 7.5 provides an overview of the water sources used in European countries to produce drinking water. The data is partly derived from IWA (IWA, 2021) and partly from EurEau, the European interest group in the field of drinking water supply and wastewater treatment (EurEau, 2021). As regards the members of EurEau, 58% of the drinking water is prepared from groundwater (including spring water), 41% from fresh surface water and 1% from salt water. Spring water is water that comes to the surface from natural sources.

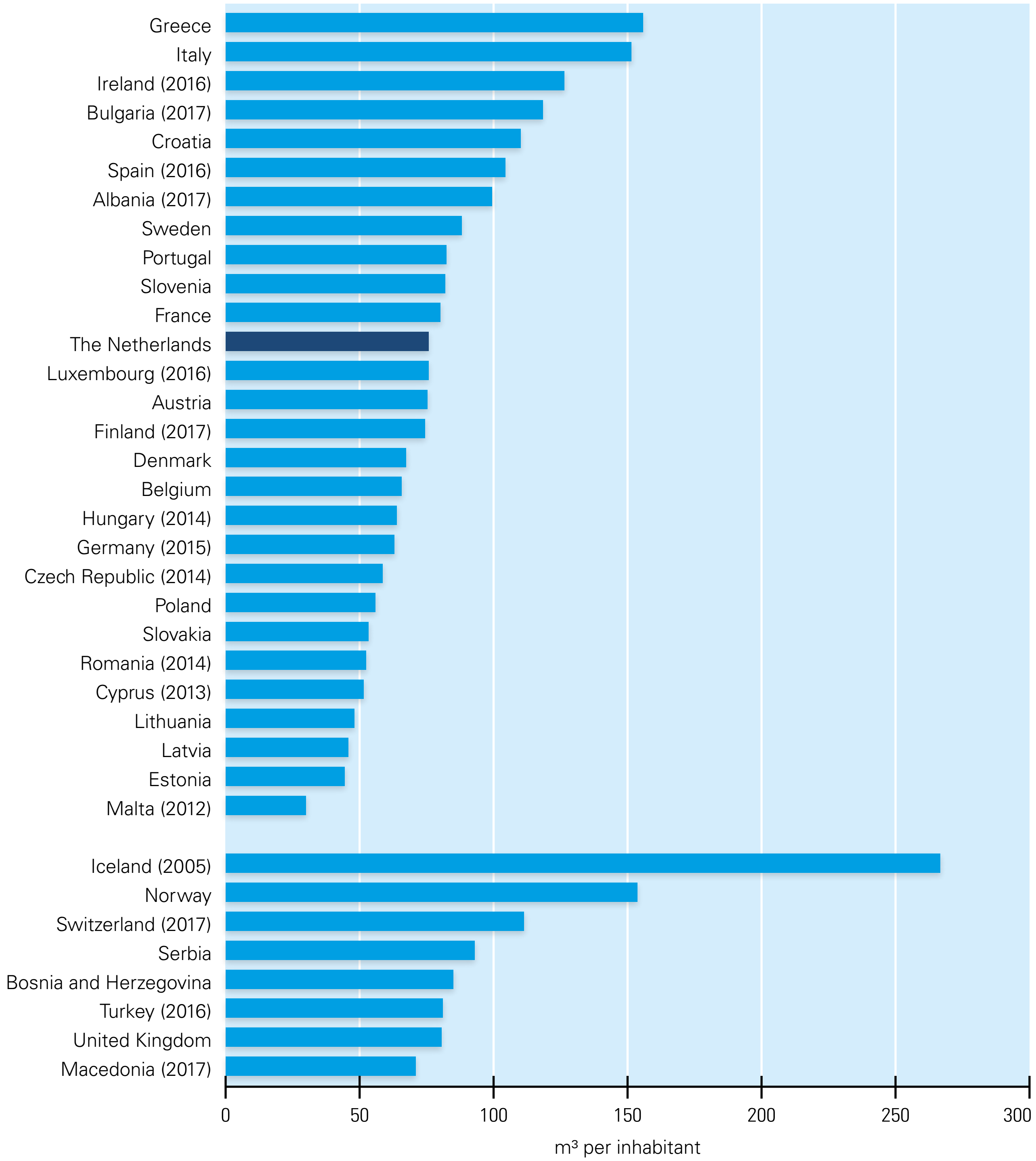
Almost all countries use multiple types of sources for the production of drinking water. Denmark is an exception to this: a total of 100% of Danish drinking water is produced from groundwater. In Belgium and France, the percentage of groundwater and surface water used for the drinking water supply roughly corresponds to that in the Netherlands. Imported water is water that comes from abroad. In the Netherlands, this was approximately 11 million m³ in 2018.

Figure 7.5 Water extraction by source for a number of European countries in 2018



(IWA, 2021; EurEau, 2021)

Figure 7.6 Freshwater abstraction for the drinking water supply in 2018



(Eurostat, 2021)

Figure 7.6 shows the extent of freshwater extraction for drinking water per person. On average, 87.9 m³ of freshwater is abstracted per capita in Europe to produce drinking water. Of the EU Member States, abstraction is highest in Greece (157.1 m³ per person) and lowest in Malta (29.9 m³ per person). In the Netherlands, 76.4 m³ per person was abstracted by the drinking water companies in 2018. Freshwater abstraction per person is highest in Iceland, a non-EU Member State.

7.2.3 Non-revenue water

Non-revenue water (NRW) is the difference between the amount of drinking water that the drinking water companies have pumped into the mains network in a year and the amount invoiced to the customers (§ 3.5.2). In addition to actual water losses, NRW accounts for use that has not been billed and measurement differences.

Figure 7.7 shows NRW for European countries united in EurEau as a percentage of the quantity pumped into the mains network. The percentage varies greatly from country to country, ranging from 6% in the Netherlands and Germany to 61% in Bulgaria. The average percentage is 25% (EurEau, 2021).

7.2.4 Drinking water use

Figure 7.8 shows domestic drinking water use per capita in the various European countries, determined by dividing the sales of drinking water companies to households for each country by the number of inhabitants. The outcome varies between 77 litres per person in Malta and 223 litres per person in Italy. The average use per capita (of countries affiliated to EurEau) is 124.5 litres per person per day. The Netherlands is slightly above that at 133 litres. This outcome is somewhat higher than the sum of the various user components in the 2016 Domestic Water Use survey (§ 3.5.3). This is partly because sales to households often also include some business use (customers having the same type of connection as households, such as small accounting offices, for example).

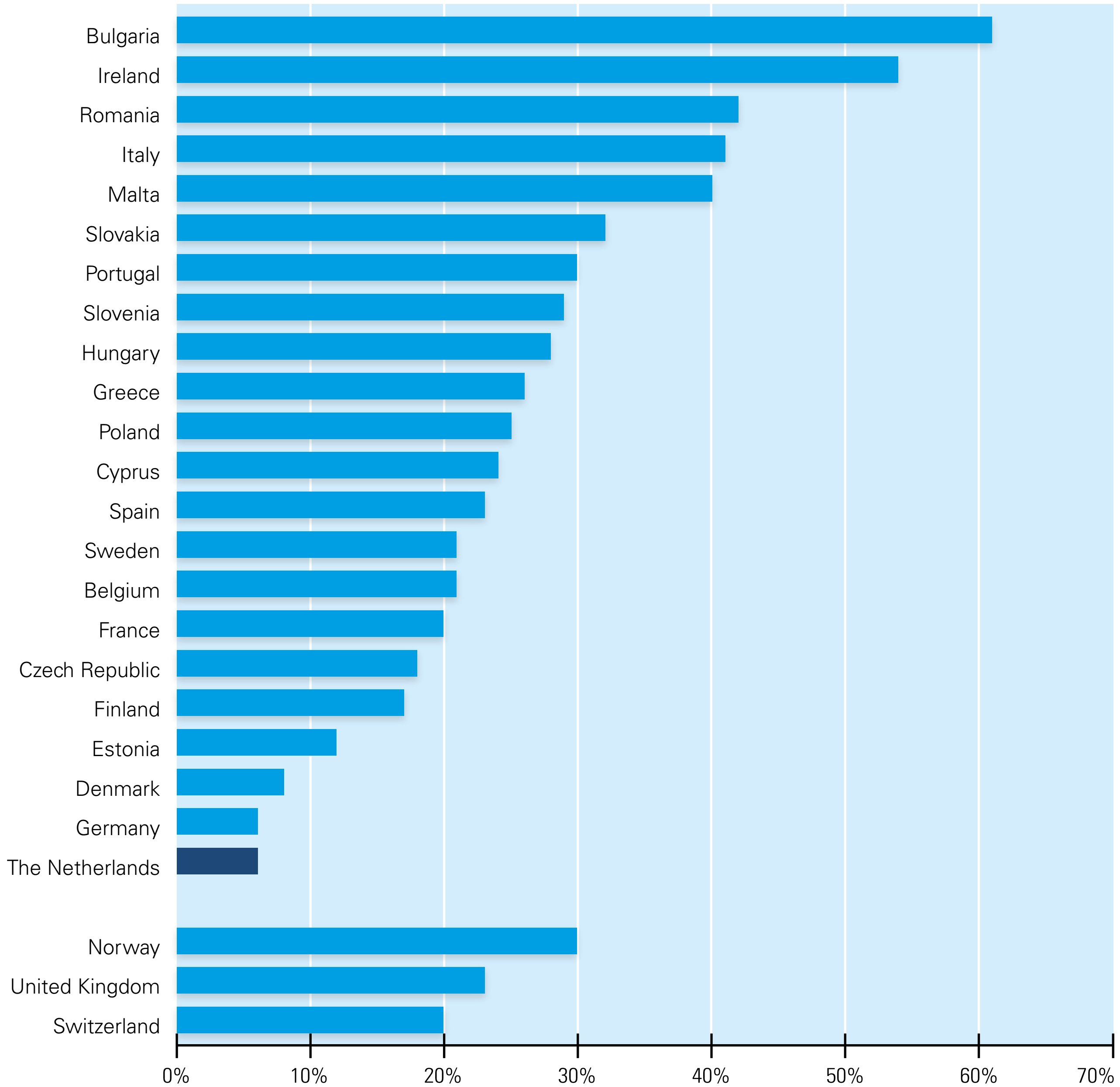
Figure 7.9 shows the use per capita in 19 European capitals. Brussels comes out as lowest at 93 litres per person per day and Moscow as the highest at 213 litres. In 2018, a total of 132 litres were used per day in Amsterdam.

7.2.5 Drinking water bill for domestic use

Figure 7.10 provides an overview of the 2019 drinking water bill for a number of countries in Europe based on a drinking water usage of 100 m³. This is the average of a number of cities in each country. Consumption taxes, such as VAT, are not included.

The drinking water bill is highest in Denmark (€262) and lowest in Italy (€55). In the Netherlands, the drinking water bill in 2019 was €140 for 100 m³. This is based on the average for Amsterdam, The Hague, Eindhoven, Rotterdam and Utrecht. Incidentally, the average domestic use in the Netherlands in 2020 is 104.9 (m³/year) and the associated annual bill excluding consumption taxes is an average of €139 (including consumption taxes €191, see § 3.7.2).

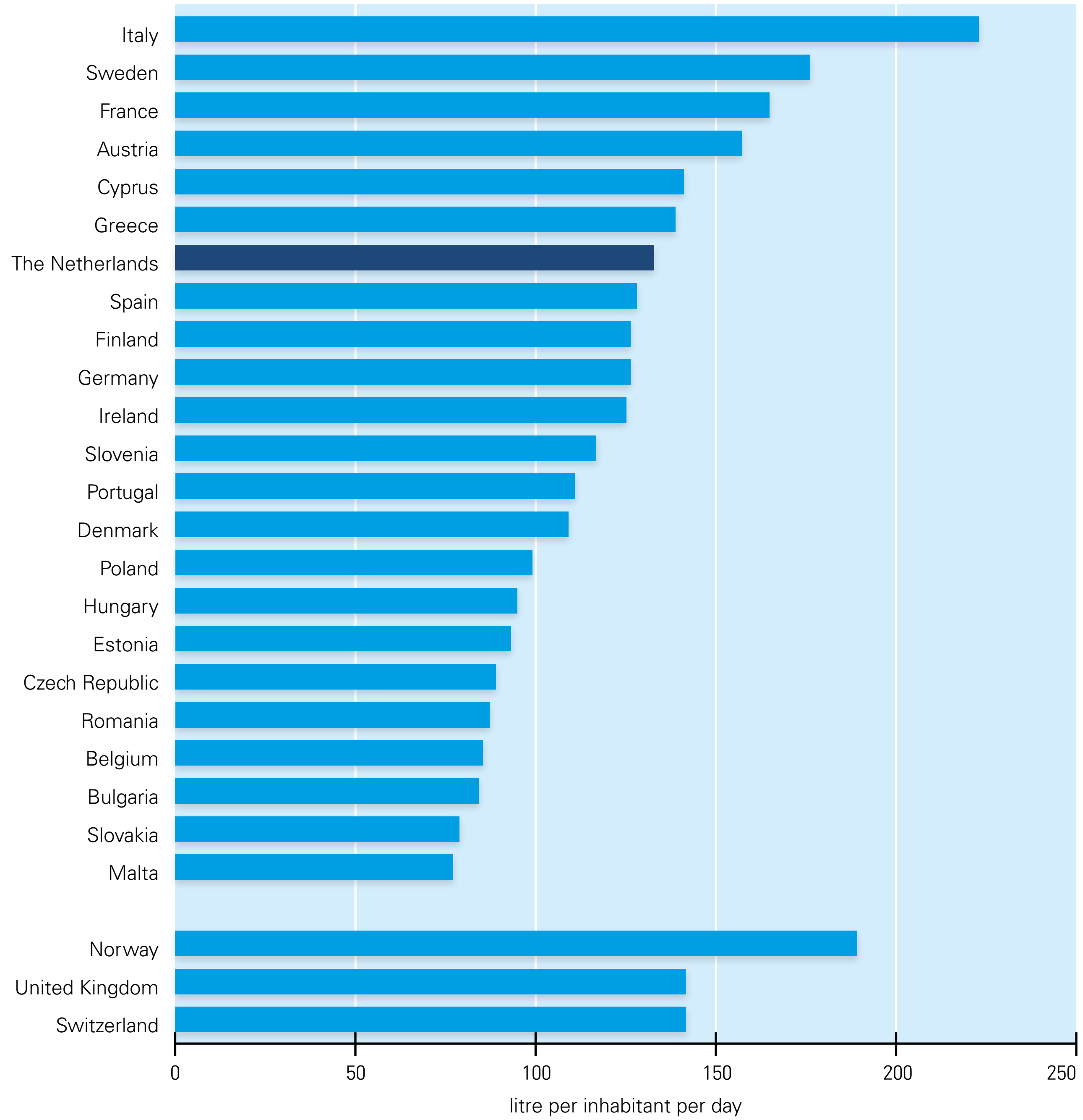
Figure 7.7 Non-Revenue Water [1)]



1) Year 2017, 2018 or 2019. This varies by country.

(EurEau, 2021)

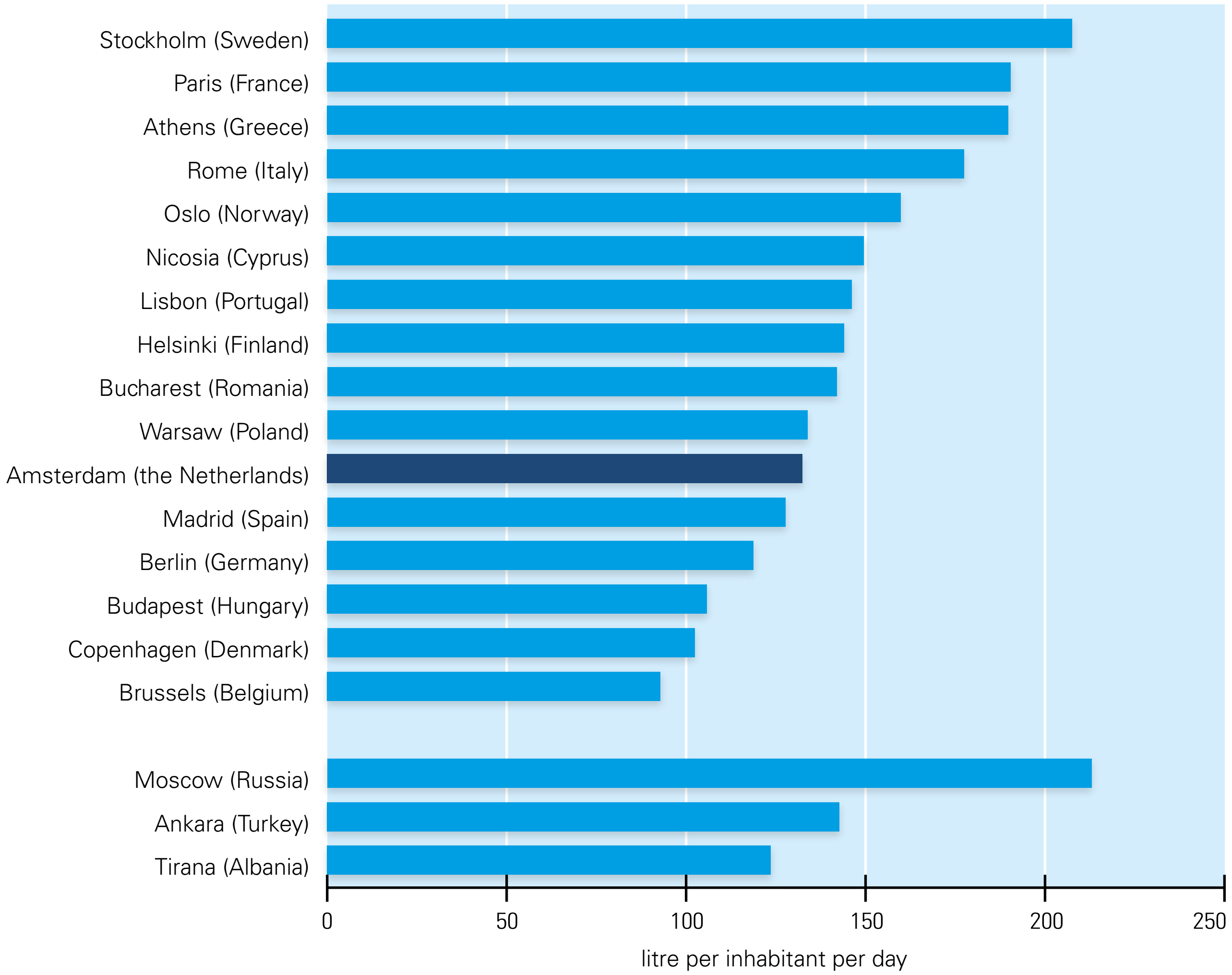
Figure 7.8 Domestic water use per capita in Europe [1)]



1) Year 2017, 2018 or 2019. This varies by country.

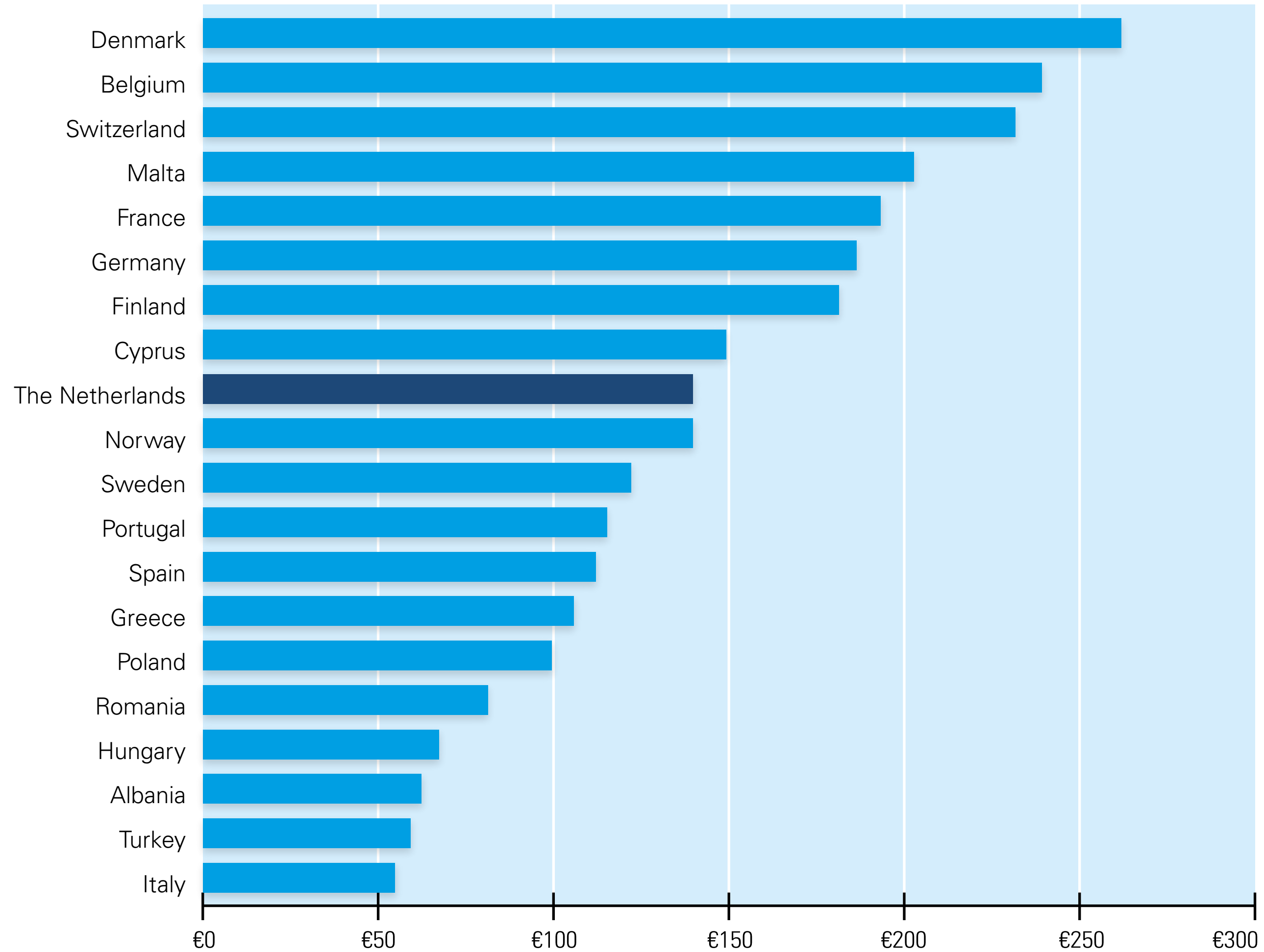
(EurEau, 2021)

Figure 7.9 Domestic water use per capita in European capitals in 2018



(IWA, 2021)

Figure 7.10 Drinking water bill in 2019 for 100 m³ [1)]



1) Excluding consumption taxes such as VAT.

(IWA, 2021)

List of abbreviations

AMPA	Aminomethylphosphonic
ASV	Additional Strategic Resources
Dww	Drinking Water Act
EU	European Union
IBA	Individual Wastewater Treatment
IenW	Infrastructure and Water Management
ILT	Human Environment and Transport Inspectorate
IWA	International Water Association
kPa	Kilopascal
m-mv	Metres below ground level
MDG	Millennium Development Goal
NEN	National Ecological Network
NGR	National Groundwater Reserves
NNN	Nature Network Netherlands
NRW	Non-revenue water
p.e.	population equivalent
p.u.	pollution unit
PBL	Netherlands Environmental Assessment Agency
PE	Polyethylene
PEEN	Pan-European Ecological Network
PVC	Polyvinyl chloride
REWAB	Register Water Quality Companies
RIVM	National Institute for Public Health and the Environment
SDG	Sustainable Development Goal
SIC	Standard Industrial Classification
STP	Sewage Treatment Plant
STRONG	Subsoil Structural Vision
UN	United Nations
UvW	Association of Regional Water Authorities
VAT	Value added tax
WBB	Waterwinningsbedrijf Brabantse Biesbosch
WEI	Water Exploitation Index
WEnR	Wageningen Environmental Research
WQI	Water Quality Index
WRK	Watertransportmaatschappij Rijn-Kennemerland
WUR	Wageningen University & Research
WWTP	Wastewater Treatment Plant

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Appendix 1: Distribution areas of water companies 2021

Brabant Water

Particulars

Supplies water to Evides Waterbedrijf, Provinciale en Intercommunale Drinkwatermaatschappij der Provincie Antwerpen S.V. (PIDPA). Purchases surface water of Waterwinningbedrijf Brabantse Biesbosch.

Distribution area

Alphen-Chaam, Altena, Asten, Baarle-Hertog, Baarle-Nassau, Bergeijk, Bergen op Zoom (partially), Bernheze, Best, Bladel, Boekel, Boxmeer, Boxtel, Breda, Cranendonck, Cuijk, Deurne, Dongen, Drimmelen, Eersel, Eindhoven, Etten-Leur, Geertruidenberg, Geldrop-Mierlo, Gemert-Bakel, Gilze en Rijen, Goirle, Grave, Haaren, Halderberge, Heeze-Leende, Helmond, 's-Hertogenbosch, Heusden, Hilvarenbeek, Laarbeek, Landerd, Loon op Zand, Meierijstad, Mill en Sint Hubert, Sint Michielsgestel, Sint-Anthonis, Moerdijk, Nuenen Gerwen en Nederwetten, Oirschot, Oisterwijk, Oosterhout, Oss, Reusel-De Mierden, Roosendaal, Rucphen, Someren, Son en Breugel, Steenbergen, Tholen (partially), Tilburg, Uden, Valkenswaard, Veldhoven, Vught, Waalre, Waalwijk, Woudrichem, Zundert.
Supplies several plots in Nederweert.

Dunea

Particulars

Supplies water to Oasen and Evides in wholesale. Supplies water to several plots in the municipalities of Beinsdorp, Delft, Hazerswoude-Rijndijk, Poeldijk, Rotterdam, Waddinxveen and Wateringen. Purchases water from Evides en Waternet in wholesale.

Distribution area

Alphen a/d Rijn (centre of Benthuizen) The Hague (excluding Wateringseveld district), Hazerswoude-dorp (Hogeveenseweg and Westzijdeweg), Hillegom, Katwijk, Lansingerland, Leiden, Leidschendam-Voorburg, Lisse, Noordwijk, Oegstgeest, Pijnacker-Nootdorp, Rijswijk, Rotterdam (Nesselande district), Teylingen, Voorschoten, Waddinxveen (at Transportweg, Bredeweg and Plasweg), Wassenaar, Zoetermeer, Zuidplas (excluding the cente of Moordrecht).

Evides Waterbedrijf

Particulars

Supplies water to Dunea and Oasen in wholesale. Supplies water to Farys and De Watergroep in wholesale (Belgium). Purchases water from Dunea and Brabant Water in wholesale. Purchases water from Water-link in wholesale. Abstracts surface water from the Meuse and Haringvliet and groundwater from its own groundwater production locations.

Distribution area

North Region

Albrandswaard, Barendrecht, Brielle, Capelle aan den IJssel, Delft, The Hague (Wateringseveld), Dordrecht, Hellevoetsluis, Hoeksche Waard, Maassluis, Midden-Delfland, Rotterdam (including Hoek van Holland and the ports), Schiedam, Nissewaard, Vlaardingen, Westland, Westvoorne and Zwijndrecht (Heerjansdam)
Supplies several plots in Rijswijk, Bergschenhoek, Ridderkerk, Delfgauw and Pijnacker.

South Region

Bergen op Zoom (Halsteren and Lepelstraat), Borsele, Goeree-Overflakkee, Goes, Hulst, Kapelle, Middelburg, Noord-Beveland, Reimerswaal, Schouwen-Duiveland, Sluis, Terneuzen, Tholen, Veere, Vlissingen, Woensdrecht.

Waterbedrijf Groningen

Particulars

Purchases water from WMD Drinkwater in wholesale. Supplies water to WMD Drinkwater B.V. in wholesale

Distribution area

Eemsdelta, Groningen, Het Hogeland, Midden Groningen, Oldambt, Pekela, Stadskanaal, Tynaarlo (Eelde-Paterswolde), Veendam, Westerkwartier, Westerwolde.

WMD Drinkwater

Particulars

Purchases water from Waterbedrijf Groningen (from Ps Nietap), but also supplies to Waterbedrijf Groningen (to Ps De Punt and to Distribution Area Sellingen) in wholesale. Supplies water to Vitens (to Ps Havelterberg).

Distribution area

Aa en Hunze, Assen, Borger-Odoorn, Coevorden, De Wolden, Emmen, Hoogeveen, Meppel (part of rural area), Midden-Drenthe, Noordenveld, Westerveld (partially), Tynaarlo (partially).

WML

Particulars

Purchase water from Kreiswasserwerk Heinsberg GmbH, Niederrheinwerke Viersen GmbH, Gemeinde Wasserwerk Waldfeucht and Wassergewinnungs- und Aufbereitungsgesellschaft Nordeifel mbH in wholesale.

Distribution area

Beek, Beekdaelen, Beesel, Bergen, Brunssum, Echt-Susteren, Eijsden-Margraten, Gennep, Gulpen-Wittem, Heerlen, Horst aan de Maas, Kerkrade, Landgraaf, Leudal, Maasgouw, Maastricht, Meerssen, Mook en Middelaar, Nederweert, Peel en Maas, Roerdalen, Roermond, Simpelveld, Sittard-Geleen, Stein, Vaals, Valkenburg aan de Geul, Venlo, Venray, Voerendaal, Weert.

Oasen

Particulars

Purchases water from Evides, Vitens and Dunea in wholesale.

Distribution area

Alblasserdam, Alphen aan den Rijn (except Benthuizen), Bodegraven/Reeuwijk, Gorinchem, Gouda, Hardinxveld-Giessendam, Hendrik Ido Ambacht, Kaag en Braassem, Krimpen a/d IJssel, Krimpenerwaard, Leiderdorp, Molenlanden, Nieuwkoop, Papendrecht, Ridderkerk, Sliedrecht, Vijfheerenlanden, Waddinxveen, Zoeterwoude, Zuidplas (centre of Moordrecht), Zwijndrecht (except Heerjansdam).

PWN Waterleidingbedrijf Noord-Holland

Particulars

Purchases water from Waternet in wholesale. Purchases pre-treated water from Watertransportmaatschappij Rijn-Kennemerland in wholesale.

Distribution area

Aalsmeer, Alkmaar, Amstelveen (partially), Beemster, Bergen, Beverwijk, Blaricum, Bloemendaal, Castricum, Drechterland, Edam-Volendam, Enkhuizen, Haarlem, Haarlemmermeer, Heemskerk, Heerhugowaard, Heiloo, Den Helder, Gooise Meren (partially), Hollands Kroon, Hoorn, Huizen, Koggenland, Landsmeer, Langedijk, Laren, Medemblik, Oostzaan, Opmeer, Purmerend, Schagen, Stede Broec, Texel, Uitgeest, Uithoorn, Velsen, Waterland, Weesp, Wormerland, Wijdemeren (partially), Zaanstad, Zandvoort.
Supplies several plots in the municipalities of Amsterdam, Eemnes, Heemstede, Hillegom, Hilversum, Kaag en Braassem, Teijlingen, Nieuwkoop.

Vitens

Distribution area

All municipalities in the provinces of Friesland, Gelderland, Overijssel, Utrecht (except Vianen), Flevoland, as well as the municipalities of Hilversum and Wijdemeren (partially) and the municipalities of Meppel and Westerveld (partially).

Waternet

Particulars

Supplies water to PWN Waterleidingbedrijf Noord-Holland and Dunea in wholesale.
Purchases pre-treated water from Watertransportmaatschappij Rijn-Kennemerland in wholesale.

Distribution area

Amstelveen (built-up area, partially), Amsterdam, Diemen, Heemstede and Muiden, Ouder-Amstel, Schiphol Airport and the former Fokker site.
Also supplies several plots in Abcoude, Landsmeer, Oostzaan and Haarlemmermeer

Appendix 2: Parameter groups and water quality index

Classification into parameter groups

Scores for non-compliance and water quality index (WQI) are broken down in the report by type of parameter, as in the 2019 Performance Comparison of Drinking Water Companies (ILT, 2020).

Table 1 Parameter groups

Health-related parameters (acute)	Health-related parameters (non-acute)	Operational parameters	Customer-oriented parameters
Escherichia coli	Arsenic	Aeromonas at 30°C	Aluminium
Enterococci	Boron	Ammonium	Hardness (total)
Legionella	Bromate (90 percentile)	Bacteria of the coli group	Colour
	1,2-Dichloroethane	Chloride	Iron
	Fluoride	Clostridium perfringens	Manganese
	Nickel	Saturation Index	Sodium
	Nitrate	Temperature	Sulphate
	Nitrite	Hydrogen carbonate	Turbidity
	Polycyclic Aromatic Hydrocarbons (PAHs) (sum)	Acidity	
	Pesticides (individual)	Oxygen	
	Tetra- and trichloroethylene (sum)		
	Trihalomethanes (sum) (90 percentile)		

'Acute' health-related parameters concern bacteria that can have a direct effect on health. 'Non-acute' health-related parameters are chemicals that can affect health if someone is exposed to them for a prolonged period of time or on a large scale. Operational parameters are data that drinking water companies measure to ensure proper operational management and customer-oriented parameters concern aspects of the drinking water that are undesirable from an aesthetic point of view, such as discolouration. Like operational parameters, these parameters do not represent any health risks.

Calculation of the water quality index

The water quality indices per parameter group presented in the report are determined in four steps:

1. Determining parameters and standardisation
The division into types of parameters is the same as the parameter groups used by ILT when calculating non-compliance in the statutory performance comparison. The Drinking Water Decree is the basis for the standard[5].

2. Entering measured values
Drinking water companies are legally obliged to regularly take measurements and to report to the ILT Inspectorate via the so-called REWAB system (Register Water Quality Companies). The data from the REWAB system are used as basis for the water quality index (WQI).

3. Calculating the water quality indices per company
At each measuring point (usually a pumping station), the average ratio between the measured value and the corresponding standard is determined for each parameter. For each measuring point, the ratio per parameter is converted into an arithmetic average for the parameter group. Subsequently, a weighted company average is calculated from the averages per parameter group of the measuring points, based on number of m^3 drinking water produced per measuring point. The outcome of this is the WQI per parameter group at company level.

4. Presenting sector results
A weighted average WQI per parameter group has been calculated for the sector as a whole based on the WQI scores per parameter group per company and the number of m^3 of drinking water produced per company. These averages are set out in Figure 4.1.

5 *The calculations of the water quality indices are as close to the standards of the Drinking Water Decree as possible. In some cases this is deviated from, for example in the event of microbiological parameters with a standard of 0. This is based on a value of 0.3 (dividing by 0 is not possible). Hardness is based on a standard between 0.0 and 2.5 in combination with a bandwidth for optimal water between 1.0 and 1.5.*

Colophon

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